Spring 4-4-2024

Re-Membering Student–Faculty Interaction within a Critically Transitive Pedagogy: A Re-Retelling of an Undergraduate Mathematics Instructor

Carrie Carmack

ACCEPTANCE

This dissertation, RE-MEMBERING STUDENT–FACULTY INTERACTION WITHIN A CRITICALLY TRANSITIVE PEDAGOGY: A RE-RETELLING OF AN UNDERGRADUATE MATHEMATICS INSTRUCTOR, by CARRIE ANNETTE CARMACK was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education & Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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ABSTRACT

RE-MEMBERING STUDENT–FACULTY INTERACTION WITHIN A CRITICALLY TRANSITIVE PEDAGOGY: A RE-RETELLING OF AN UNDERGRADUATE MATHEMATICS INSTRUCTOR

by

CARRIE A. CARMACK

Under the Direction of David W. Stinson, Ph.D.

There are several studies that provide evidence to suggest that undergraduate students' interactions with faculty are central in shaping their engagement, which enhances their learning outcomes and influences their decision to remain enrolled (Cole & Griffin, 2013; Kim & Lundberg, 2016; Kim & Sax, 2017, 2009). But most studies on student–faculty interactions do not consider the unique attributes that constitute interactions. Researchers in the past few decades who have considered conditional attributes have examined effects across gender, race, first-generation status, age, and social class (e.g., Cole & Griffin, 2013; Kim & Sax, 2017). Once these conditional attributes were taken into consideration, the evidence suggested that student–faculty interactions are not always beneficial for every student; in fact, they are the most often mentioned way that minoritized students' engagement and learning might be hindered (Kim & Lundberg, 2016; Park et al., 2020b).

Therefore, in this study, I took a closer look at student–faculty interactions by examining interactions as contextual and contingent experiences. I employed analytic autoethnography (Anderson, 2006) to examine the *self*, characterized as the *Subject*, by interrogating her past values, beliefs, and perspectives as an undergraduate mathematics educator. I used, largely, past course syllabi over several years and, in part, transcribed colleague and student interview data to highlight the Subject's transforming perceptions, beliefs, and values in mathematics teaching and learning. The Subject's pedagogical transformations toward a critically transitive pedagogy were a result of her shifting values and perceptions of mathematics and the student learner, which shaped her interactions with her students.

I employed a critical postmodern framework (see Stinson, 2009; Stinson & Bullock, 2012, 2015) to consider how student–faculty interactions are politically situated, maintained, and reproduced through systems of power and power relations. I examined the context of the Subject's pedagogical transformations and applied Foucault's (1982) concept of power relations to the analysis to illuminate the influences in her transformations. By applying Foucault's conceptualization of power, I recognized that the Subject's perception contained power relations that operated when she confined a student's mathematical self through "traditional" perspectives of mathematics and mathematics pedagogy. All in all, using a critical postmodern framework for this study provided conceptual tools to reveal how traditional mathematics pedagogical practices are hindering the learning of many (most?) undergraduate mathematics students and to point the way toward more productive possibilities—a critically transitive pedagogy.

INDEX WORDS: Analytic Autoethnography, Critically Transitive Pedagogy, Student–Faculty Interactions, Undergraduate Mathematics

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in

The Department of Middle and Secondary Education

in

The College of Education and Human Development

Georgia State University
Atlanta, GA

DEDICATION

To my students—past, present, and future—I dedicate this to you.

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I would like to acknowledge and express my gratitude to my committee members. To Dr. Fournillier and Dr. Boyles, thank you for your insight, honesty, and commitment to ethical research and education. I appreciate the time I had with you in our courses and feel that I truly have learned from the best. To Dr. Jett, your support, encouragement, and friendship will always be appreciated. I am thankful we got to work alongside each other. To my advisor, Dr. Stinson—I could not have done this with anybody else. Thank you for giving me space to grow while supporting me every step of the way. I will forever cherish our time working together.

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I would like to thank my family, friends, and colleagues who have supported me along the way. Your encouragement kept me going, your willingness to collaborate brought me inspiration, and your friendship brought me joy. Thank you to those across campus who have supported my pedagogical development, and a special thank you to my colleagues in University College and those I worked with at the Center for Teaching and Learning.

2022

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ABBREVIATIONS

ASU: Arkansas State University

CRT: Critical Race Theory

GSU: Georgia State University

USG: University System of Georgia

UWG: University of West Georgia

CHAPTER 1

BACKGROUND AND RESEARCH QUESTIONS

Over the past few decades, nearly all U.S. colleges have established strategies aimed at retaining students (Berger et al., 2012). The University System of Georgia (USG) has several initiatives targeting student retention, and the USG institution where I work, the University of West Georgia (UWG), has been actively supporting these initiatives. One ongoing initiative is the Momentum Year, described as a collection of strategies designed to guide students on their path of successful degree completion and on-time graduation ("What is Momentum Year?," n.d.). The Momentum Year provides guidance to students for their enrollment decisions and offers suggestions to faculty for improving student retention in their courses. As an undergraduate mathematics faculty member at UWG for the past 12 years, I have been actively engaged with the Momentum Year initiative. I have attended Momentum Year conferences, presented at the 2020 Momentum Summit, and along with my colleagues in the UWG Freshman Mathematics Program, was awarded the 2020 Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation. For this award, my colleagues and I highlighted our efforts that align with the strategies suggested in Momentum Year, such as using open educational resources for our course text, offering co-requisite learning support courses, and fostering a growth mindset.[1] One strategy offered to students by the Momentum Year initiative is a program map that attempts to eliminate uncertainty regarding their course choices. The program map recommends that students complete their core mathematics course within their first

[1] Growth mindset is the notion that a student's approach to learning can negatively or positively impact the experience. A growth mindset views learning as a process and a belief that a student, with the right mindset and resources, can perform to standards. A fixed mindset is an approach to learning that assumes some minds are incapable of learning certain material (Dweck, 2008).

year of college. Vincent Tinto (1975, 1993), a prominent researcher of student retention, identified the first year of college to be an especially important time for student retention. It is during this time that students transition into the academic community and gain their sense of belonging-to the academic institution by engaging with its members, specifically, the faculty. Studies have provided evidence to suggest that students' interaction with faculty is central in shaping their engagement, which enhances their learning outcomes and influences their decision to remain enrolled (Cole & Griffin, 2013; Kim & Lundberg, 2016; Kim & Sax, 2017, 2009). Some of these learning outcomes include higher college GPA, persistence, social integration, growth in cognitive or intellectual skills, greater educational aspiration, gains in academic self-concept, and degree attainment (Cox et al., 2010; Kim & Lundberg, 2016; Kim & Sax, 2009; Park et al., 2020a; Pascarella & Terenzini, 2005).

Even before the Momentum Year initiative, which began in 2018, I participated in other initiatives aimed at student retention and improving the DFW[2] rates in introductory undergraduate mathematics courses (e.g., college algebra and precalculus). One such initiative, Intervention Tutoring, provided funding to pay peer tutors to hold small group-study sessions for students in college algebra and precalculus courses. This initiative was modified and received funding through the University System of Georgia STEM IV grant, Targeted Interventions in Precalculus and Calculus, where I served as Co-PI. Within the last few years, however, while working on these various initiatives, my values, beliefs, and pedagogy have radically[3] changed. I have experienced seismic shifts in my perspective of mathematics teaching and learning. The beliefs, values, and actions that resulted from these seismic shifts, which I identify as my

[2] DFW is defined as the percentage of enrolled students that earned a grade D, F, or withdrew from the course.

[3] In this context, radically refers to a divergence from the current "traditional" cultural norms of and attitudes about mathematics and undergraduate mathematics teaching and learning.

critically transitive[4] pedagogy, provide the context to this study, entitled *Re-membering Student–Faculty Interaction within a Critically Transitive Pedagogy: A Re-retelling of an Undergraduate Mathematics Instructor*.

My shifting perspectives of mathematics education occurred in part because of my engagement in the doctoral program (i.e., Doctor of Philosophy in Teaching and Learning with a concentration in Mathematics Education) at Georgia State University, which began Fall 2017. My perspectives are a result of me spending years engaging in literature, experimenting pedagogically, and critically challenging the conventional understandings of mathematical knowledge and mathematics teaching and learning. In turn, I have altered the ways I teach, what I value, and how I interact with students. It was not a simple transformation. I had to reside in uncomfortable spaces and think honestly about my own beliefs and practices. I had to consider how I reproduced harmful discourse and how I was placing boundaries and limits on students while stifling their creativity in the ways that I taught and in how I interacted with them. Engaging in the literature was necessary for this process because it provided me with opportunities to broaden my understanding of what mathematics *is*, resulting in a better understanding of how students use and respond to it.

A critically transitive pedagogy is an always changing, fluid pedagogy. It is unique to each teacher and requires them to regularly interrogate their own beliefs and practices to uncover the ways they might be harming students. I reflected on the past several years and considered how my pedagogy has shifted. I thought about the beliefs, actions, and values that I currently maintain that could characterize my critically transitive pedagogy and condensed them into two

[4] A Freirean-based pedagogy that recognizes the transformative power of the individual. Critically transitive teaching is demonstrated in the mathematics classroom when students and teacher make broad connections between individual experience and social issues.

main strategies for teaching mathematics: (a) prioritize ethics, and (b) value all students. Ethics is a commitment to treat all persons fairly and to act in a way that will benefit others. Learning mathematics enhances knowledge, improves skills, and has social benefits, so the mathematics teacher has an ethical responsibility for her students (Ernest, 2019). She has a responsibility to care for her students and teach mathematics in a way that is beneficial for them and prioritizes their wellbeing. Prioritizing the student's wellbeing aligns with the second major strategy of teaching within a critically transitive pedagogy: to value all students. To value every student means to treat each of them respectfully and equitably[5] (as opposed to equally). That is not to suggest that all students should be equally measured using common assessments. It means that teachers must attend to individual needs while accommodating the various achievement levels of the students in the course. In Chapter 5, I describe how I applied these strategies and offer details on specific assignments used to meet these goals.

A critically transitive pedagogy requires self-reflection and must remain open to interrogation, critique, and change. Although I am positioned within a space that places boundaries and limits on what I can do, I must negotiate within this space and accept certain restrictions and mandates that prevent change and maintain unequal power relations (Foucault, 1982, 1990; Walshaw, 2001). A critically transitive pedagogue must contend to this issue. I do so by prioritizing my interactions with students and resisting classroom practices that categorize, label, and control them. This prioritizing means radical changes in the mathematics classroom, where customarily a primary pedagogical practice has often been to categorize and label students based on their "ability" to perform mathematical procedures on timed exams; where support is offered to those who perform poorly, and opportunities for those who perform well. I do not

[5] Treating students equitably refers to treating them impartially. Treating students equally refers to treating them all in the same way.

argue against offering support or opportunities, the problem goes beyond these remedies. For example, when students are tested, then categorized and labeled, they are no longer conceptualized as human learners. Instead, they are represented by a numerical measurement. This measurement then becomes their value; the goal is no longer care and support for the human learner, it is about improving their measurement. I resist these practices by restructuring what I value in the mathematics classroom, in turn, influencing my interactions with students.

For this study, I conducted an analytic autoethnography (described later) to examine student–faculty interactions within the context of a critically transitive pedagogy. An analytic autoethnography allowed for an exploration of an experience that is highly contextual and influenced by a myriad of social and personal values, beliefs, and perspectives. In this study, I explored those values, beliefs, and perspectives on the subject, the self. Theoretically, I structured my study within a critical postmodern frame (Stinson & Bullock, 2011, 2015). This theoretical framework provided the grounding I needed to examine student–faculty interactions as a contextual, contingent, political, and social phenomenon influenced by experiences, relationships, values, and beliefs. The research question I sought to answer was:

1. How does the Subject describe her experiences interacting with students within the context of a critically transitive pedagogy?

In this chapter, I describe the emergence[6] and evolution of my critically transitive pedagogy by using a historical timeline of my pedagogical transformations. This timeline, necessarily painstaking in detail at times, situates my pedagogical values and beliefs, and provides the historical context for the research participant: the *self*.

[6] Emergence refers to an "awakening of consciousness" (Stinson, 2009); moments when I became aware of social injustices within mathematics education.

Historical Timeline of My Rethinking Pedagogy

Autoethnographers, described by Chang (2008), "complement 'internal' data generated from researchers' memory with 'external' data from outside sources, such as interviews, documents, and artifacts" (p. 55). Personal memory is a unique source of data that can tap into information to which other ethnographers do not have access. Theoretical frameworks on the nature of memory have evolved through time. Up through the 20th century, philosophers conceptualized memory as a storehouse full of unchanging images representing a person's experiences and beliefs (Senor, 2009). The act of remembering these images was considered a process of retrieving them from their storehouse. Early philosophers promoted this idea by developing the representational theory of memory. Senor described this theory, it—

> claims that the object of your immediate awareness in memory is a representation or image, and that it is in virtue of your now having that image that you are now able to recall the event you are remembering. (Section 1.1)

David Hume (1711–1776) was an early philosopher who debated the nature of memory (Senor, 2009). He contributed to the representational theory of memory by asserting that the immediate objects of cognition are representations, which he divided into two types: (a) impressions, and (b) ideas. He described impressions as the building blocks of cognition, made up of forceful sensations, passions, and emotions. When the impression makes its appearance again, its image becomes an idea, but only if it retains some of its force. In this case, Hume identified the idea as a memory image. Otherwise, it would be of the imagination. Over a century later, Bertrand Russell (1872–1970) expanded upon this description. He claimed that memory is dependent on the relationship one has with it. He argued that memory required both an image and a feeling of belief (Senor, 2009).

The representational theory of memory had its fair share of critics, Thomas Reid (1710–1796) being one of the most severe (Senor, 2009). He believed memory to be immediate, not a storehouse full of images waiting to be retrieved. He argued that the object of memory is something of the past, yet our remembrance of it exists in the present moment. Rather than the mind retrieving ideas, Reid maintained that the mind generates representations of the past where memory can alter what enters it. Memory not only stores ideas, but it can combine with other beliefs and change as time passes.

In outlining my historical timeline, I recall experiences and beliefs I had in the past, recognizing that they have been altered as time moved forward. I chose these experiences because they contributed to my pedagogical transformations and contextualize my academic positioning at a specific point in time. Some of the memory data, specifically data on pedagogical practices, include external data and connections to social theory. I have organized my memory data chronologically.

I begin my timeline in Spring 2005, when I first began teaching in a higher education classroom. I was a graduate student at Arkansas State University (ASU) working toward my Master of Science degree in Mathematics. The only experience I had in a classroom prior was as a student. I was a good student. I maintained high grades throughout my public-school days and did especially well during my kindergarten through sixth grade education at a private Catholic school. After high school, I attended community college in my small, White hometown in Arkansas, then transferred to ASU, a college in a larger but still mostly White town. I planned to major in biology to go into optometry, but after attending a calculus class at ASU, my teacher pulled me aside and suggested I switch my major to mathematics, so I did. I obtained my Bachelor of Science degree in Mathematics and began graduate studies at ASU in January 2005.

Spring 2005–Summer 2011

After accepting a graduate assistantship for Spring 2005, I was placed in a course to teach developmental algebra.[7] I presented the course material, making sure I was organized and showed every step of the mathematics problems being solved. I received some compliments from students on my lectures, which validated my belief that my teaching style was easy to follow. With these compliments and my past experience as a "good" mathematics student, I concluded that if a student could not do well in the courses I taught, it was because they were not studying, not prepared, not coming to class, not doing homework, or some other student-directed excuse I told myself. My interactions with students during this time were almost nonexistent. I never tried to initiate a conversation with them and did not even consider that to be a problem.

During my graduate school experience, I decided teaching was not something I would enjoy nor was I good at. After graduating Arkansas State University in 2007 with a Master of Mathematics, I decided to forgo a teaching career and try something else, but my options were limited. I had little professional experience and a degree that did not seem to matter much in the current job market. I was recruited by an insurance agency to sell insurance and was moved to another small, all White town in Arkansas. This career path did not last long, and soon after I was living in my parents' basement. I decided to try teaching again when I was informed of an adjunct position at my local community college. With my housing and basic needs met by living with my gracious parents, I applied for the job and began teaching again in Fall 2009. I was surprised to find myself enjoying it this time around. I was getting to know the students better too. I accepted another adjunct position and after one year of adjunct work, I accepted a full-time

[7] Developmental algebra can be classified as a noncredit course specifically for students performing low on standardized exams. Based on performance, students could be placed into developmental algebra or intermediate algebra. Once students completed these courses, they were deemed "prepared" for the credit bearing course, college algebra.

position in a small, mostly White retirement town in Arkansas. I accepted this position the same month that I began dating my future husband. He lived near Atlanta, Georgia, over 600 miles away. We maintained our relationship long distance for a year, but the distance prevented us from moving forward in our relationship, something we both wanted. I quit my job, packed my bags, and applied to the only open faculty position near to where we were going to be living, the University of West Georgia (UWG).

Fall 2011–Spring 2012

After packing up and moving in June of 2011, I was offered a job at UWG as a limited term instructor. It was clear they needed faculty. There were six of us hired initially, and I walked into a fall semester with over 300 students to teach. They were all large lecture classes, but I was comfortable lecturing and felt confident in the procedures and steps I would show students. I created detailed, organized, well thought-out notes for students to copy as I worked through the content and explained each step during the lectures. These types of lectures constituted the type of mathematics courses I had as a student, so I mimicked this pedagogy. All the mathematics courses I had been exposed to up to this point exhibited a similar structure. Within this structure, the teacher transmitted the mathematical procedures and methods to the students by writing problems out on a board and working through them, and the students validated their understanding by replicating these procedures. If students could easily and accurately get through timed tests, they were perceived to have learned the mathematics. The role of a mathematics teacher, then, was to provide clear and accurate lectures, maintain fair grading policies, and provide feedback on student work. The role of the student would be to come to class, ask questions, do the homework repetitively, study the procedure, get help if needed, and then take a test or quiz articulating the procedure and arriving at a correct answer.

One problem with this model is that when students and teachers both adhere to their role and assume that the student will test well, if they do not test well, then it is often perceived as a student-directed issue. Early on in my teaching, I would assume that a student would not be putting in their part when they did not do well on the tests. I had this belief when I started teaching at UWG, and I also held the assumption that if a student did their part but still did not perform well, then they did not receive adequate preparation for the course. To help the student, then, was to provide academic resources, such as tutoring, so they could obtain what they were "lacking."

For my first semester at UWG, I had been assigned a Supplemental Instruction[8] (SI) leader to help the students with the content outside of class. Assessments during this first semester, and for almost a decade after, were usually in the form of tests and quizzes, where students work through the procedures that were covered in class to arrive at an appropriate answer.

Fall 2012–Spring 2014

During Fall 2012, the Dean of the College of Science and Mathematics attended our faculty meeting and asked that we consider applying for internal grants being offered through larger initiatives aimed at student success. A senior colleague approached me and suggested I consider applying for one, and that I could perhaps explore SI. A summer stipend was being offered to participate, so I quickly said yes. I met with my chair, attended some workshops, and submitted my proposal (see Appendix A for the submitted proposal, authored under my maiden name, Thielemier). To summarize the proposal, I categorized the students into risk categories of failing the class: (a) low-risk, (b) moderate-risk, and (c) high-risk. To determine this risk, I

[8] Supplemental Instruction are group study sessions, led by an SI leader, that take place outside of the classroom. SI leaders are current students who have taken and excelled in the specific course they are supplementing for.

developed a pre-quiz consisting of content and survey questions (see Appendix B). The goal was to use the pre-quiz to measure how prepared the student was, then collect their SI attendance and compare these findings to their average final grade. I used the same pre-quiz for three semesters, along with the same syllabus and grading structure in my courses. I conducted class the same way I had always taught mathematics and made no significant changes. Each semester I would play[9] with the data, and I found the same pattern emerge. I combined all three semesters of the 296 final grades with the students' SI attendance, then categorized the data based on the students' risk-category, and the same pattern appeared again (see Figure 1).

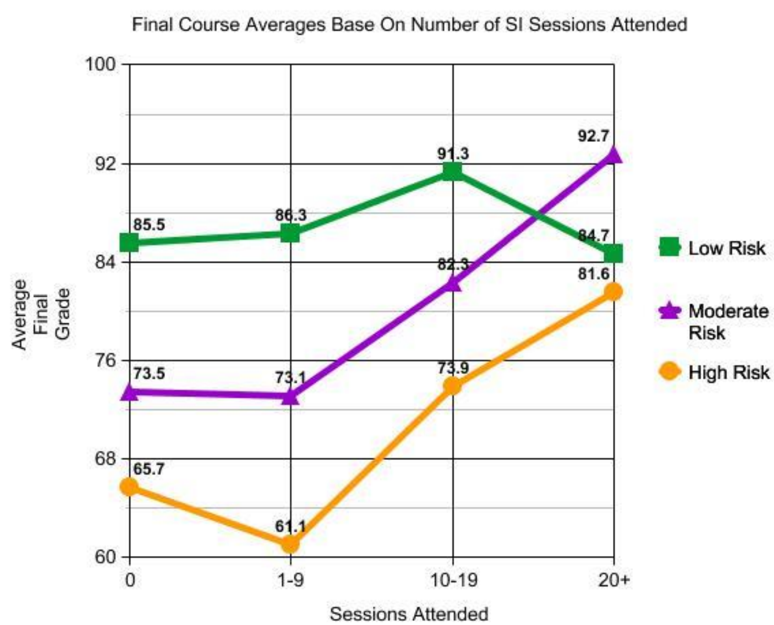

Figure 1. Graph illustrating an emerging pattern in data based on students' average final grade compared to number of SI sessions attended.

I submitted this information in my report for Spring 2014 (see Appendix C), where I concluded:

> After analyzing data for Math1111, it appears that SI is an effective tool for those who are moderate to high-risk students. Students who are low risk may not have to use

[9] I use the word play to indicate that I had no experience collecting and interpreting data, so analytical research methods were not used. I merely grouped data together in different ways to look for patterns.

> additional resources to succeed in the class. Students who are high risk may benefit more from one-on-one tutoring if they do not plan to attend 10 or more sessions. It is recommended that moderate risk students also attend more than 10 sessions so that they are more likely to receive a better than average grade. *My end goal is for Math1111 instructors to have the ability to categorize students based on a variety of easily obtainable factors and [promote] what resources work best for each categorization* [emphasis added]. Giving a student this type of information within the first week of class will help them manage their time and understand what is expected for them to succeed. This may also encourage instructors to start incorporating these resources within their courses, so students have a much better chance of passing the class with a strong understanding of the topics covered.
>
> My next step in this research project is to focus on high-risk students who fall in the 1–9 sessions attended. It is my assumption that these particular students are making some effort but may get discouraged throughout the semester. Although I cannot predict how many SI sessions a student will attend, I can use this data to motivate a student to either attend SI 10 or more times, refer them to tutoring, and keep constant contact with them throughout the semester (Proposal Report, Spring 2014).

Fall 2014–Fall 2017

After submitting the proposal report, I applied for more funding to expand the project and create group-study sessions for the high-risk students so they could receive more individualized help. I named the project Intervention Tutoring given that I am not creative when naming projects. At this point, I wish to make explicit that I hate this name and I cringe when I hear it. But “intervention” was where I was at the time. My reported results were included in the application for the 2020 Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation (see Appendix D). My colleagues and I were presented the award in January 2020. In the section entitled Use of Evidence-Based Strategies to Foster a Growth Mindset (pp. 113–117), I go into detail with the findings and where my colleagues and I were with the program up to Fall 2019.

During the implementation of Intervention Tutoring, I became interested in student–faculty relationships because of the interactions I was having with my students. In the beginning of the project, I wanted to encourage my high-risk students to attend the tutoring sessions, so I decided to invite them to my office to meet with me so I could promote its benefits. I found meeting with students was rewarding, and I felt I developed a closer relationship with them. I also found that the students seemed to respond to the tutoring sessions well. These perceived benefits encouraged me to begin meeting with all my students and promote the tutoring sessions to everybody. This time commitment was difficult, but class size had gotten smaller at this point. I was meeting, on average, 60 students each semester. I held these office meetings for several semesters, along with another colleague who agreed to partner with me and implement the tutoring sessions in his courses as well. He also met with all his students because of the perceived benefits he found. When he and I spoke of the project with colleagues and at conferences, we highlighted these student–teacher meetings. The experience of meeting with my students individually launched my interest in exploring the social influences of student learning.

In fall 2017, I enrolled at Georgia State University (GSU) for a PhD in Teaching and Learning in Mathematics Education. The first couple of semesters I was just trying to keep up with the reading and writing. I had been out of school for a decade, and my prior college experiences—both undergraduate and graduate—consisted largely of completing problem sets. I struggled with the readings, but I engaged with them, even if I had no idea what the author was trying to convey. I studied what I read and followed the advice of my major advisor: to summarize, pull quotes, and reflect on everything I read. It was about a year into the program when I became familiar with the literature enough to begin to understand and articulate theoretical mindsets. This moment is when I began to recognize my critical consciousness.

Summer 2018–Fall 2019

In summer 2018, I enrolled in a critical theory course at GSU with Dr. David Stinson, my major advisor. We were assigned to read Marx and Engel's (1848/2002), *The Communist Manifesto*, which provided the historical positioning of the origins of critical theory and its connection to class oppression. We then read Paulo Freire's (1970/2000), *Pedagogy of the Oppressed*, which emphasized the humanization of mathematics education and encouraged me to reflect on my own approaches to mathematics pedagogy. This encouragement helped me to recognize my critical consciousness. Through my past course writings, I can locate these moments. Below I reference my written reflections on Freire (1970/2000) when I was enrolled in the course:

> He [Freire] explains the cycle of oppression, and how to overcome it. It gives me a lot of opportunity to reflect on how to incorporate a culture in my mathematics classroom that is free of oppression. It's not going to be easy. I very much use the banking method of teaching. I'm good at it, and students consider me a great teacher because I can organize material in a way that makes it easy for them to memorize it or make minor connections with it. Can I escape that type of learning in a class full of foundational knowledge? I may be an organized lecturer, I may care about my students, and I may offer opportunities for them to learn, but I oppress them in the way I teach my class. We do not

> have authentic dialogue, and I would be surprised if they left my class with a belief that they can use what they have learned to transform their world. (Summer, 2018)

As my coursework continued that semester, further readings influenced my critical consciousness. Such readings included Greer and colleague's (2009) edited volume *Culturally Responsive Mathematics Education*. This book outlined the development of mathematics and situated mathematics education within historical, cultural, social, and political contexts. Engaging with the many contributors of this volume helped me recognize there is no history of mathematics that is free from cultural influences. When putting culturally responsive teaching in practice, it does not assume that mathematics is neutral, objective, and free from influence, but rather advocates for its influence to be used to self-empower students (Mukhopadhyay et al., 2009). At this point in my life, I had never considered mathematics in this way. Mathematics was always presented to me as an objective science based on fact and absolute truth. Throughout all my education, I never read about the history and social context of mathematics and mathematics education. I did not regard mathematics to be community knowledge, and I never once considered that access to mathematics education has been used politically as a means of reproducing social and educational inequality (deMarrais & LeCompte, 1999; Mukhopadhyay et al., 2009). Furthermore, I never pondered the question "What *is* mathematical *knowledge*?" and during a decade of teaching undergraduate mathematics, I never pondered the question "What *is* mathematical *knowing*?" Until my second semester at GSU, when I enrolled in an epistemology and learning course with Dr. Deron Boyles. In this course, I was asked to answer the simple question: What is knowledge? Although now I would define knowledge to be socially justified belief bound by discourse, I struggled to find an answer to this question back then. This struggle is illustrated in my written answer for Dr. Boyles below, where I attempt to answer the question by avoiding the question:

> Before answering the question "what is knowledge," I would like to first discuss how knowledge may be acquired. One carries with them a set of morals, prejudices, experiences, and a culture. My past experiences are completely different from another's, and although they may overlap, these experiences are subjective, as are my morals and my prejudices. My understanding of this world is shaped by these subjective experiences and the environment I live in. When my experiences overlap with another's, knowledge is acquired. From this overlap, we may come to understand something we have never known before, we may find similarities or differences in our separate experiences, and the knowledge may even be false, but it is still acquired. This acquisition can be done through books, discussion, or any means of communication. Knowledge, however, is merely a tool. It is how we attempt to understand and know the world around us. *Knowledge is how we come to know objective truth* [emphasis added] (Spring 2018).

It was during Dr. Boyles's course that I began to think about knowledge and what my own beliefs about knowledge might be. We read and discussed different perspectives, but I was still grappled with mathematics as anything other than objective science. We read Lyotard's (1984) *The Postmodern Condition: A Report on Knowledge*. I struggled with making sense of some of the points being made. Some points stuck, however; I realized that several semesters later when I read the book again in Dr. Stinson's course on postmodern theory and mathematics.

Spring 2020–Fall 2020

In January 2020, a group of undergraduate mathematics colleagues and I were awarded the 2020 Regents' Momentum Year Award for Excellence in Teaching and Curricular

Innovation (see Appendix D for the submitted application). Unfortunately, this same semester was when the COVID-19 pandemic hit. USG moved to online teaching the week of our spring break, which was a tiresome adjustment, but I managed. Between March 2020 and June 2020, I developed college algebra into a fully online course, dependent on online, multiple-choice quizzes and exams. I continue to use this content for current online course offerings. During Summer 2020, I enrolled in the postmodern theory course with Dr. Stinson, online. Early on we were assigned to read Lyotard's (1984) *The Postmodern Condition: A Report on Knowledge*. In this book, Lyotard analyzes modern knowledge in an information-processing society. He first positioned knowledge in a space contingent upon efficiency and commodity, where education finds its legitimacy based upon its optimization and performance for the social system (Usher & Edwards, 1994). Central to Lyotard's stance was his turn to language. He captured the role of grand narratives[10] in legitimizing modern scientific knowledge and how knowledge is bound to the language games[11] society plays. He then suggested a different perspective to knowledge. One that recognizes knowledge as bound to language, not as objective and absolute. Lyotard suggested accepting these limits but to understand these limits are never established once and for all. He encouraged resisting the perspective that situates knowledge as if it is absolute and fixed, and to reject grand narratives and challenge the status quo. Further readings into postmodern theory explained that these perceptions of objectivity are derived from educational theories and practices that hold the modernist assumptions that certainty can exist, mathematical knowledge can validate certainty, and that the objects of mathematics can provide the rationality needed to

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[10] Grand narratives are accounts of human experience that are totalizing and camouflage social and economic inequality.

[11] Lyotard (1984) defined language games in terms of the various utterances that make up a conversation. He explained that "each of the various categories of utterance can be defined in terms of rules specifying their properties and the uses to which they can be put" (p. 10).

uncover the reality in which we reside (Ernest, 2004, 2009). These assumptions of certainty ignore the social influences of knowledge production, elaboration, and legitimation (Ernest, 2004). That is exactly what Lyotard had argued to resist. By rejecting these assumptions and instead assuming knowledge does have social influences, Lyotard foretold that those who have access to this knowledge, in an information-processing society, will hold powerful positions.

As I began to understand knowledge and access to that knowledge as a source of power, my classmates and I dove deeper into power relations by exploring works of Michel Foucault (1982, 1990). Usher and Edwards (1994) described Foucault as a critic of discourse, whose work emphasized the constitution of subjects through discursive practices. His work focuses on the emergence of modern institutions and the forms of governance associated with them. Foucault explained how modern governance repositions people into tighter forms of regulation and self-regulation, secured through social institutions.

I continued to think about systems of power and how they differentiate. I considered how I labeled and categorized my students, how I subjected them through my own interactions and how that could have influenced them. I thought about how these categorizations created boundaries and limits, much like the boundaries and limits of language that Lyotard described. I thought about Lyotard's suggestion to accept the limits, but recognize they are never established once and for all. They are not fixed or absolute.

As I engaged with the postmodern readings in the course, I began to make significant changes to my pedagogy. As Fall 2020 approached, the country was still in the middle of a global pandemic with no vaccination. The University System of Georgia had decided that the University of West Georgia would move teaching to a hybrid model. Students would attend class face to face, one day a week, and the rest of the course was to be conducted online. This model led to many challenges, and I was reluctant to conduct class face to face. I feared that I would catch a virus that was killing thousands of people. Most students felt as I did and chose to complete the class online. I had materials for college algebra already developed, but I was teaching precalculus too, so I had to develop online material for that course. It just so happened that my immediate need to redevelop a course was happening the same semester that UWG went through a complete system reorganization. The aim was to locate first-year student academic and support services in one unit. This unit, University College, houses the Department of General Education, where faculty who teach first-year mathematics courses and first-year English courses reside. Other departments in University College include the Center for Interdisciplinary Studies, the Department of Civic Engagement and Public Service, Academic Transition Programs, the Department of Multicultural Achievement, and the Department of Academic Excellence. With my move to this newly formed University College, I thought it would be a great opportunity to make radical pedagogical changes, so I eliminated every exam in precalculus (see Appendix E for the course syllabus). I replaced the exams with a reading and writing project. I explained this project in my 2020 Annual Faculty report (see Appendix F), I wrote:

> This project encouraged students to think about what mathematical learning *is*, to consider social and cultural aspects to mathematics education, and to think about and connect to the mathematics in their everyday lives. (Annual Faculty Report, 2020)

By incorporating the writing assignments in precalculus, I did feel as though I got to know my students through their writing. Similar to what I had done in my graduate coursework, I had students read academic sources, summarize, and reflect. Reading their thoughts and reflections was incredibly worthwhile, and feedback from the students indicated that they appreciated this approach. I decided to continue to explore this pedagogical practice in my other courses.

During Fall semester 2020, I also enrolled in a Sociology of Education course with Dr. Joyce King at Georgia State University. It was during this semester that I connected knowledge and social power to mathematics education. I explored the links of economic power to mathematics education by examining the perspective that education serves economic purposes. I learned about the history of U.S. education system devaluing Black students. We read on the effects of enslavement to education, the massive resistance to desegregation efforts, the control of free market capitalism penetrating our schools, and the structured system of White privilege that reproduces inequality (deMarrais & LeCompte, 1999; Fleming, 2018; Jensen, 2005; Rooks, 2017; Valenzuela, 1999). I began to understand the absorbent negative effects that White supremacy has always had, and continues to have, in U.S. social systems.

My research interest in student–faculty interactions continued to develop during this semester. I thought about research topics and what I wanted to study for my dissertation. I had narrowed it down to a study on faculty perspective of student–faculty interactions. My comprehensive exams were coming up in Spring 2021. I had decided to do a case-study design examining faculty perspective of student–faculty interactions. My theoretical perspectives aligned with critical and postmodern theories, but I had concerns about representing participants and I did not think I would be able to access a lot of different types of data. I decided to move forward with my comprehensive exams anyway with the plan. I completed the exams at the end of Spring 2021 but decided to change my study to an analytic autoethnography during Fall 2021.

Spring 2021–Fall 2021

In Spring 2021, UWG went back to fully face-to-face teaching. Classes were scheduled so that students could distance themselves and campus policy was to wear a mask inside buildings. I did not make many changes to my pedagogy this semester. I was preparing for comprehensive exams and teaching a course I had not taught for several years. Thankfully, I was also teaching college algebra again, so the familiarity was helpful. I offered students bonus points for their multiple choice, face-to-face final exam (which is departmentally mandatory) if they attended class. This semester was exhausting. The stress of going back to face-to-face teaching, still without a vaccine, was overwhelming. The joy I got out of teaching and the interactions I usually had with students were so limited during this time, so I struggled to find happiness. Things started to turn around by the end of the semester. I completed and passed my comprehensive exams, the vaccine for COVID-19 was available, and I was scheduled to teach a fully face-to-face precalculus course that summer, so I knew I could do another reading and writing project. I decided to make another significant change for that class, especially considering it only had about a dozen students. With my concerns of testing and categorizing students, as well as my thoughts on power relations among faculty and students, I did not develop a syllabus. I wanted the students to have input in the types of assignments they had, their grading structure, and class policies. The course objectives stayed as is, so the precalculus content did not change. (See Appendix G for the course syllabus.) With the small class size, I was able to give each student their own individualized grading plan. Overall, they decided they wanted in-class assignments for the technical content, they wanted to complete a reading and writing project, and they wanted other various writing assignments. This course, however, was quite a rollercoaster ride.

I believe I developed sincere relationships with my students in this course. Unfortunately, there was one student enrolled who exhibited hostile behavior toward me and a student early in the semester. He was allowed to remain in the course, which caused tension because the other students did not want him to be there, nor did I. A couple of weeks later he showed hostile behavior again toward another student, so he was finally removed. This removal allowed the remaining students and me to relax for the rest of the summer semester and finish the course. This specific course brought joy back to teaching. Seeing the students' work and developing positive relationships with them was rewarding. This course also aligned well with my graduate coursework. It was also during this summer that I had enrolled in a critical pedagogy (described later) course with Dr. Deron Boyles. It was in this course where I began to articulate my critically transitive pedagogy. To have a critically transitive pedagogy, I had to consider what a critical pedagogy was. In a previous course, Dr. Boyles challenged me by asking "What is knowledge?", in this course, he challenged me by asking "What is critical pedagogy?" Although Dr. Boyles noted several lingering problems with my statement, I wrote the following:

> Critical pedagogy problematizes the modernist assumption that all of knowledge can be reduced to a mathematically produced system in which the probable occurrence of any event can be calculated. This assumption has created a social framework that operates to order and control human experience, where human subjects are to serve the interests of this framework (in the name of progress). That which does not fit the structure is excluded, thus creating boundaries and limits to what is of value. This exclusion contradicts the basis of a democratic and just society, yet the educational policies and practices derived from this assumption have dominated modern educational institutions. As a result, an undemocratic hierarchy of beliefs, values, and practices is in place and

> reproduced in our society. This hierarchy creates and perpetuates a reality where difference is inferior and therefore, diversity is suppressed. A critical pedagogue shatters this hierarchy by revealing whose values, beliefs, and goals are privileged, and how they are imposed upon society. They act to transform and reconstruct this reality by promoting classroom interactions and experiences where students can identify sources of domination, reinterpret their own lives, and value difference. (July 2021)

For Fall 2021, to better value student input, I again entered the classroom with a partially developed syllabus. I am required to give a 40 question, multiple-choice final exam in the courses I was assigned, so that was included. The course objectives did not change, I required writing assignments, and I included a midterm exam, solely to prepare them for the final exam. (See Appendix H for course syllabus.) The students and I then created a course that allowed us to explore mathematics more broadly. We lessened the impact of test grades and heighted the impact of in-class assignments. In the writing assignments for the course, students reflected on humanist teaching and learning, explored culture in mathematics, and synthesized mathematical literature. One student was able to capture a desired outcome for this course in their final reflection:

> This semester I have been able to think more on the culturally important views of math such as asking, “Where did mathematics first originate?” and “How did it spread/change over time?” This has given math more of a humanistic view rather than such a harsh black and white tone. Because of this, the course was more approachable, and I could see the real value of actually learning college algebra.
>
> As far as looking into my time in this classroom, I have been so grateful to my professor and how she runs the classroom. I am given an extreme amount of patience,

> validation, respect, and kindness. Through these traits I have been allowed to grow so much in the classroom and truly immerse myself into the content without a score on a test holding me back in fear. Because of this, I have learned so much more than in my previous math courses combined as I can simply just focus on the content. To elaborate further, in the Algebra course I took at my high school last year, everything was weighted on tests, and my teacher was very strict when it came to mental health and coursework. This in turn created a lot of pressure for me and caused a lot of distaste in how I viewed mathematics in the classroom. My mental health was at an extreme low and it felt impossible to push through; I felt alone and so behind all the time. Moving forward to this year, I have had an amazing time and enjoyed every second in the classroom. I think that most of that is in fact because of how I am treated, and I think that goes a long way in how a student can perceive a given course. (Fall 2021)

During this semester, I also enrolled in a critical race theory course (CRT) with Dr. Nickolaus Ortiz. CRT can be used as a tool to analyze race, respond to systemic racism, and critique White supremacy (Dumas & ross, 2016). CRT has provided me a different sort of lens to place on experiences, interactions, and on teaching and learning. A lens that can uncover systems of power and domination that, as a White woman, I may not have considered without it. One such example would be what Love (2004) describes as majoritarian storytelling. Love explained that majoritarian stories are "the description of events as told by members of dominant/majority groups, accompanied by the values and beliefs that justify the actions taken by dominants to insure their dominant position" (pp. 228–229). One such majoritarian story is the achievement gap narrative. This narrative conceals White privilege by perpetuating the idea that there exists some sort of deficiency in a Black student's ability to learn, and thus, they are unable to perform well on standardized exams. William Tate, one of the initial scholars to conceptualize CRT in mathematics education, refers to the structure that perpetuates this narrative as the inferiority paradigm (Davis & Jett, 2019). The inferiority paradigm is built on the belief that Black children are inherently inferior to White children. For example, prominent figures in American society, like Thomas Jefferson, justified enslavement by perpetuating a false narrative that Black people were biologically and intellectually inferior to White people.

The inferiority paradigm is working in higher education today, although it is not as loud and explicit, it is now subtle and hidden (Bullock, 2019). Now it finds its power lurking in its racist assumptions. For example, Pierre Bourdieu's 1977 social theory assumes White, middle-class culture is the valued one (Yosso, 2005). He calls this value "cultural capital" (deMarrais & LeCompte, 1999) and if a person does not have this capital, they are in some way deficient, in other words, inferior. Although this use may not have been Bourdieu's intention, his cultural reproduction theory has grounded a substantial amount of literature aimed at deficit thinking. In fact, Yosso (2005) argued that deficit thinking has been the most prevalent form of contemporary racism in U.S. schools.

Mathematics education research has further perpetuated the inferiority paradigm by its focus on poor performance among Black students (Bullock, 2019). In the inferiority paradigm, if the student is unsuccessful in mathematics, they are assumed to have inferior mathematical skills or a lack of motivation (Bell, 2009). Students could achieve high scores on mathematics exams and be on that direct path to economic success if only they "worked harder and fixed the things that are wrong with them (their culture, their language, their community and neighborhoods, their families, their ethics, their values)" (Love, 2004, p. 232). Bullock (2019) identified 20th century mathematical reform movements, such as Mathematics for All and the Standards

Movement, that operated within the inferiority paradigm. She included recent examples of educational discussions operating in this paradigm, which include discourses on grit and growth mindset. Recall, the Momentum Year initiative perpetuates the narrative of growth mindset. If faculty are working in the inferiority paradigm and promote growth mindset, they could engage in harmful interactions with students.

As I was exploring racial perspectives of mathematics education "remedies," I was also thinking about how I would conduct a study on undergraduate mathematics faculty perspectives of student–faculty interactions. Many undergraduate mathematics faculty operate within a traditional image of mathematics teaching and learning. In this image, mathematics is understood as objective and culture-free, where teaching mathematics focuses primarily on the transfer of skills through drills and rote memorization that can be easily measured through standardized testing (Leistyna & Woodrum, 1996; Moschkovich & Nelson-Barber, 2009). This type of teaching stems from 20th century efforts to create mathematics curricula where rigor and precision were emphasized. The mathematics curriculum during this time was written as formalistic, abstract, and stressed precise thinking demonstrated by a use of precise terminology (Swetz, 2009). Today, this formulaic mathematics is still privileged in higher education. For example, institutions that value formulaic replication have used scores such as the SAT or ACT to place students in mathematics courses based on their measured "ability" to perform well on these tests.

Many faculty in undergraduate mathematics courses privilege this formulaic thinking too. If it is the only way mathematics was taught to them, and without disruption, it is the only way they can conceptualize teaching it. I was taught mathematics in this way and so were the undergraduate mathematics faculty whom I initially were seeking as participants. Conducting a study on undergraduate mathematics faculty, who have only experienced the traditional image of mathematics and therefore operate within it, where I would interrogate their pedagogy and critically examine their perspectives of student–faculty interactions, had potential to cause unnecessary harm. Furthermore, I did not want my study to be a critique on undergraduate mathematics faculty, many of whom want only the best for their students. We only differed in that I had gone through a transformation of sorts and had developed an “attitude to critique” the traditional image of mathematics education (Valero, 2004). The idea of examining mathematics faculty who may operate within the very construction I was critiquing was not what I was interested in exploring. With these considerations, and after witnessing my progression over the past 3 years, my advisor suggested I consider analytic autoethnography.

Concluding Thoughts

Conducting an analytic autoethnography on student–faculty interactions within the context of a critically transitive pedagogy highlighted my transforming perceptions, beliefs, and values in mathematics teaching and learning. Throughout this research inquiry, I continued challenging traditional conceptualizations of mathematics, which shaped the interactions I had with students. These interactions were examined at socially constructed and situated moments. To examine student–faculty interactions in this way, they needed to be historically contextualized and thoroughly reviewed.

In Chapter 2, I map the development of student–faculty interaction as a research topic in higher education and document the evolution it has experienced since. I discuss major theories that influenced the study of student–faculty interactions, I summarize the recent findings of student–faculty interactions, specifically in mathematics education, and I conclude with a broad overview of current mathematics education pedagogies.

In Chapter 3, I discuss my philosophical considerations and the specific theories that framed this study. I situate my theoretical positioning by providing a brief historical account of different possibilities for conducting mathematics education research and describe how an eclectic critical postmodern theory informed this work. In Chapter 4, I provide details of my chosen methodology, an analytic autoethnography. I summarize the research design, discuss the ethical considerations of analytic autoethnography, and identify limitations in the design. Chapter 5 provides details of data interpretation, analysis, and representation. I used syllabi as evidence of pedagogical transformations, and I explain how these moments contributed to the results of this study. I conclude with Chapter 6, where I summarize the study and describe the results and limitations of it.

CHAPTER 2

LITERATURE REVIEW

In this chapter, I contextualize the studies on student–faculty interactions by reviewing the history, theories, and omissions within the relevant literature. The review is organized into three sections: (a) early studies, (b) theories on student–faculty interaction, and (c) the critical approach. A review of early studies provides a history of sorts of student–faculty interactions. A review of theories of student–faculty interaction describes the theoretical and conceptual models used in many studies on student–faculty interaction; and for the critical approach, I discuss more recent research that provides a sense of criticality to studies of student–faculty interaction. I conclude the chapter with an overview of current undergraduate mathematics pedagogies and why my study is a needed contribution to the literature.

Early Studies

Student–faculty interaction emerged, so to speak, as a research topic after numerous studies had been conducted on student retention (Berger et al., 2012). Interestingly, student retention did not appear as a research topic until the 1960s. These studies were conducted to better understand student departure and how it related to the students' individual characteristics (Aljohani, 2016; Berger et al., 2012; Tinto, 1993). The studies suggested that student departure was a condition of personality attributes and therefore, recommendations were made for college admissions criteria to prevent admitting students who were deemed likely to drop out (Berger et al., 2012). Toward the end of the decade (1960s), studies were conducted that considered social contexts and how they related to student departure. Then, prominent researchers, such as Alexander Astin and Alan Bayer, called for a more systematic examination of student retention (Berger et al., 2012; Demetriou & Schmitz-Sciborski, 2011).

The 1970s marks the start of theory building in student retention studies and the consideration of the relational variables involved in a student and their college environment (Aljohani, 2016; Burke, 2019; Spady, 1970; Tinto, 1975). Spady (1970) developed an initial conceptual model to understand the process of student departure and was one of the first researchers to attempt to move beyond exploring student characteristics (Burke, 2019; Spady, 1970). Spady used Émile Durkheim's 1951 theory of suicide to link an attribute of suicide to one of student departure; that is, both are removal of oneself from a society. Spady proposed that the variables contributing to students' satisfaction and commitment to their institution are related to the students' social integration in their college environment (Burke, 2019; Demetriou & Schmits-Sciborski, 2011). His conceptual model began to explain that this social integration is an interactional process (Berger et al., 2012).

Spady's model served as a precursor to Vincent Tinto's (1975, 1993) ground-breaking model of student integration. Tinto's conceptual model was also based on Durkheim's theory of suicide, but he also relied heavily on Arnold Van Gennep's 1960 study on social integration (Aljohani, 2016; Burke, 2019). In this study, Van Gennep explored rites of passage in tribal societies and found that members of the community evolved into new relationships by going through three phases: separation, transition, and integration (Aljohani, 2016). Tinto compared these phases to a student's first year of college, when they must separate themselves from their old community, transition into their new academic community, and finally, integrate into their new community by identifying themselves as members of it. Tinto theorized that persistence in college is largely guided by students' perception of their own adjustment and belonging-to this social and academic community. He claimed that if students are unable to perceive themselves as adjusting to and becoming members of their institution's academic community, they are more likely to voluntarily withdraw from the institution because they do not achieve a sense of belonging. Additional literature provided supporting evidence that as students' sense of belonging increase, their likelihood of being retained from year one to year two increases (Burk, 2019; Ishler & Upcraft, 2005).

Tinto's conceptual model has been used extensively in studies that explore student retention, and motivational theories have developed in part as a result of these explorations (Demetriou & Schmits-Sciborski, 2011). The most widely applied motivational theory in undergraduate retention literature is attribution theory. This theory was developed by Bernard Weiner in his 1970 and 1980 studies where he examined what success and failure are attributed to. By applying this theory to Tinto's conceptual model, several studies have provided evidence that student–faculty interaction can positively influence retention by socially and academically integrating students into the university community (Cole & Griffin, 2013; Kim & Lundberg, 2016; Kim & Sax, 2017, 2009). The role of faculty is emphasized in Tinto's (1993) work, where he claimed:

> The character of one's integrative experiences after entry [to college] is central to the process of voluntary withdrawal. Of particular importance are those experiences which arise from the daily interactions between students and faculty inside and outside the classroom. Other things being equal, the more frequent and the more rewarding those interactions are seen to be by the student, the more likely the student is to persist. (p. 82)

Tinto's conceptual model paved the way for the early studies of student–faculty interaction. These studies emerged in the 1980s, when Ernest Pascarella and Patrick Terenzini were conducting most of the empirical work that used the model (Kim & Sax, 2017). Their work was a precursor to the explosion of studies that happened next. These early studies examined the roles that faculty serve when assisting students with their college experiences and measured mostly the frequency and type of student–faculty interactions in college (Cole & Griffin, 2013). Pascarella summarized these early studies in his comprehensive reviews, published in the 1980s and early 1990s, that documented the research on the effects of student–faculty interactions on college outcomes and cognitive development (Cox et al., 2010, Kim & Sax, 2009). Since then, many studies have been conducted that claimed frequent student–faculty interaction enhances student outcomes, such as college satisfaction and persistence (Barnett, 2011; Chang et al., 2008; Chang et al., 2011; Crisp, 2010; DeAngelo, 2014; Fischer, 2007; Flynn, 2014; Gordon et al., 2008; Kim & Sax, 2017; Mamiseishvili, 2012, Tovar, 2015).

These early studies provided a foundation of the study of student–faculty interaction in higher education. Since then, student–faculty interaction has been considered one of the most widely regarded college experiences associated with positive college outcomes (Kim & Sax, 2017). The ongoing research into this social dynamic has resulted in the development of conceptual models and social theories that assist educators in understanding the complexity of student–faculty interactions. In the following section, I discuss several of the models and theories that have been extensively cited in the literature.

Theories of Student–Faculty Interaction

Kim and Sax (2017) provided a comprehensive review of the study of student–faculty interaction in U.S. colleges. They described quantitative and qualitative studies conducted that closely examined the general and conditional effects of student–faculty interaction. They organized the quantitative research into categories relevant to the effects of student–faculty interaction, which included: (a) populations studied, (b) measures of student–faculty interaction, (c) student outcome measures, (d) types of effects, and (e) methodological approaches. The qualitative research discussed in the review examined the nature and outcomes of student–faculty interaction. The studies referenced have explored the experiences of students of color, the unique differences in student–faculty interaction based on students' gender, and faculty expectations. The literature on student–faculty interaction is grounded in different theoretical and methodological approaches. Kim and Sax described several approaches employed by researchers, along with the college impact models and theories from sociology and psychology to understand the dynamics of student–faculty interaction.

Researchers used college impact models to explain how student–faculty interaction might influence college student outcomes (Kim & Sax, 2017). Astin (1984) used involvement theory to assert that frequent student–faculty interaction was the most influential type of student involvement and was associated with a wide range of student outcomes (Kim & Sax). Weidman's (1989) model of undergraduate socialization suggested that student–faculty interaction allowed students to assess the aspirations, values, and aptitudes they had upon entering college and either modify or maintain them (Kim & Sax). Tinto's conceptual model (1975, 1993) is of course the most widely used college impact model that asserted that student–faculty interaction can influence students' persistence in their first year.

Theories from sociology and psychology are also useful for explaining the role of faculty in college students' learning and development (Kim & Sax, 2017). These theories explore the link between student–faculty interaction and student outcomes. They include: (a) socialization theory, (b) social capital theory, (c) social exchange theory, and (d) theory of student validation. Kim and Sax described socialization as "the process by which individuals acquire the norms, values, knowledge, and skills that allow them to participate and perform successfully in an organized society" (p. 92). Researchers used socialization theory to explore how student–faculty interactions influence understanding of the normative contexts of their institution. Studies have highlighted the importance of faculty in this process because they can influence values and social norms of the institution (Cole & Griffin, 2013). Social capital theory focuses on the relationships among student and faculty to explore how this relationship might provide students with various forms of academic and social support. These relationships may differ among different groups of students, and the research relying on social capital as a framework have highlighted the ways faculty can provide minoritized students with information-rich networks (Cole & Griffin). Social exchange theory, as described by Kim and Sax, "suggests that faculty may decide whether or to what degree they form relationships with students based on their perceived balance between the costs and benefits of such a commitment" (p. 93). This theory asserts that relationships are more likely to be built with those who believe that the relationship will offer benefits as they exchange resources and support. Another link to relationship building can be explained by the theory of student validation. It has been used to understand how supportive experiences among a student and faculty can possibly contribute to the student's success. Receiving validation from faculty enable and confirm students' perceptions of their own capability of learning and achieving success (Kim & Sax).

The majority of studies on student–faculty interaction that Kim and Sax (2017) cited used quantitative approaches. Researchers examined the relationship between student–faculty interaction and select college outcomes or explored the patterns and predictors of student engagement with faculty. There have been some qualitative studies conducted that investigated the conditions and outcomes related to student–faculty interaction, but most examined the outcomes of student–faculty interaction and the experiences of students (Kim & Sax). There are a handful of studies that captured the expectations and experiences of faculty (Anderson &

Carta-Falsa, 2002; Collier & Morgan, 2008; DeAngelo, 2010; Lewis & Abdul-Hamid, 2006; Menchaca & Bekele, 2008; Perna et al., 2009; Ryser, Halseth, & Thien, 2009). For instance, Anderson and Carta-Falso (2002) conducted a qualitative study to explore what students and faculty wanted in their relationships. By using a phenomenological methodology, they analyzed the written narratives of faculty and students. Anderson and Carta-Falso found that "both students and instructors reported a desire for open, supportive, comfortable, respectful, safe, or non-threatening, and enjoyable interpersonal climate" (p. 136). They indicated that the qualities of the interactions "appear to be important factors needed to create a positive environment for teaching and learning" (p. 137). Anderson and Carta-Falso revealed that student–faculty interaction can be dependent upon factors such as classroom environment and desires among both students and faculty. Collier and Morgan (2008) investigated another factor by exploring faculty members' expectations and students' understanding of those expectations. They used data from focus group discussions and interpreted the differences and similarities among traditional and first-generation students. Collier and Morgan used sociological role theory to ground their research. Sociological role theory is a type of socialization theory that connects a student's social integration to the student's mastery of a specific social role. The social role that was examined with their study was that of the normative college student, a role in which Collier and Morgan claimed was critical for student success. They also investigated if different subgroups of students experienced expectations in a different way. Their findings indicated that students, in general, often had difficulty interpreting faculty expectations. This difficulty was heightened more for first-generation students than for traditional students. Although the understanding of conditional effects on student–faculty interaction remains theoretically and empirically underdeveloped, research in the past few decades has considered these conditional effects by examining them across gender, race, first-generation status, age, and social class (see, e.g., Cole & Griffin, 2013; Kim & Sax, 2017).

Kim and Sax (2007) conducted a quantitative study that analyzed data collected at a large and diverse research university. They examined “the impact of three types of student–faculty interaction across five student outcomes, and how the effects of such interaction vary by student’s race, gender, social class and first generation status” (p. 13). Their study revealed that there were “gender and racial differences in the impact of student–faculty interaction across undergraduate student outcomes, though no such differences by class or first generation status” (p. 15). The findings, however, did not reveal any clear patterns into the nature of the conditional effects.

To further the exploration of conditional effects, Kim and Sax (2009) conducted another study to investigate the differences of six outcome measures among student types based on gender, race, social class, and first-generation status. Their findings indicated that “there existed complex dynamics in the relationships between student–faculty interactions and educational outcomes that depended on the type of faculty interaction, the specific student outcome, and the students’ characteristics” (p. 447). They revealed differences in the frequency of student–faculty interactions and differences in the effects among different student categories. Kim and Sax provided evidence that student–faculty interaction may be more or less beneficial for some groups of students than others. In fact, findings from Kim and Lundberg (2016) suggested that student–faculty interaction was the most significant way that minoritized students were hindered. This moment in the literature marks the emergence of the critical approach to studying student–faculty interactions. In the final section of this review, I discuss several studies that can be located within a critical (broadly defined) framework which reveal student–faculty interaction is not beneficial for every student and uncover the negative effects of discriminatory interaction.

The Critical Approach

The critical approach to the study of student–faculty interaction marks the moment when studies appeared that explored the complex dynamics of student–faculty interaction and disrupts the assumption that it is beneficial for everybody. I narrow this review further and discuss studies that investigated the experiences of individuals from groups that are historically underrepresented in higher education, and then more specifically, to historically underrepresented students in STEM. The body of research addressing student–faculty interaction in STEM, however, is relatively small compared to the broader body of research on STEM in higher education (Park et al., 2020a).

The progression of the research literature on student–faculty interaction has been a result of the shifting demographics of college enrollments. College campuses have gone from being largely White to more racially and ethnically diverse environments (Cole & Griffin, 2013). With a more diverse environment, researchers have been able to investigate the discriminatory or negative interactions that may exist among different groups of people, revealing subtle systems of power that may reproduce and perpetuate inequalities. Cole and Griffin focused on this diversity in their comprehensive review of student–faculty interaction. They explored the frequency, quality, and outcomes of student–faculty interaction and how it varied based on the social identity of those interacting. Cole and Griffin cited several studies that suggested students of color seek out same-race mentors, which may then create more of a burden for minority faculty members due to the increased workload (see Chang et al., 2014). In addition, they identified a number of studies that investigated the effects of racism among student–faculty interaction, and racial inequity within higher education (see Park et al., 2020a, 2020b)

Chang and colleagues (2014) examined the factors that contributed to the persistence of underrepresented racially minoritized undergraduates in STEM fields. They identified an initial negative relationship between faculty mentoring and persistence in STEM. Their model "showed that higher levels of faculty mentorship were associated with a higher probability of switching to a non-STEM major" (p. 570). Upon further investigation, Chang and colleagues found that lower faculty mentoring was evident among underrepresented racial minority persisters in STEM. Settings in STEM are predominantly White spaces with White cultural norms (Ong et al., 2011; Park et al., 2020a). If students seek out same-race mentors, the lack of mentoring opportunities among minoritized students in STEM could be a product of the lack of diversity in STEM faculty generally.

Other studies have documented that racially minoritized and female students often experience discrimination from faculty (Carlone & Johnson, 2007; Ong et al., 2011; Park et al., 2020a, 2020b). Park and colleagues (2020a) examined discrimination from faculty in STEM and linked it to retention in their study on 562 STEM undergraduates. Their results showed that traditional forms of student–faculty interaction did not predict STEM retention once the effects of discrimination from faculty and other control variables were considered. Students in STEM who reported that professors made them feel uncomfortable because of their race and/or ethnicity had a lower probability of staying in STEM.

This finding was especially pronounced for Black and Latinx students. It was further identified that Black students in STEM were most likely to report experiencing racial and ethnic discrimination from faculty, and other researchers have documented that Black students have high rates of interaction but also have more negative experiences (Kim & Sax, 2009; Park et al., 2020a).

To investigate racial discrimination among student–faculty interaction in STEM further, Park and colleagues (2020b) showed how "racial discrimination from faculty is negatively mediating the otherwise generally positive link between student–faculty interaction and GPA, highlighting some of the processes by which racial discrimination from faculty negatively shapes academic experiences" (p. 8). Their quantitative study indicated that "students who interacted more frequently with faculty also were more frequently exposed to experiencing racial discrimination from faculty because of race/ethnicity, which negatively affected college GPA" (p. 1). This finding directly links racial discrimination from faculty to lower college GPAs in STEM, and Black STEM students are particularly susceptible to this negative dynamic. Park and colleagues hypothesized that dominant groups (e.g., White students) will not experience this discrimination and will be more likely to reap benefits from interaction with faculty (Park et al., 2020b).

While a critical approach characterizes the studies that disrupt the assumption that student–faculty interactions are beneficial for everybody, this study is located in what I characterize as a socio-critical approach. Here, student–faculty interactions are examined as a political, social, contingent, and contextual phenomena, influenced by power relations.

Concluding Thoughts

In the United States, a predictable, consistent method of mathematics teaching and learning has prevailed. This method can be characterized as a "traditional pedagogy" (Hiebert, 2007). In a traditional pedagogy, curriculum is repetitive, demanding, and mostly deals with calculating, defining, and replicating procedures. Students' conceptual knowledge is often ignored. Traditional pedagogies are not serving students well, yet mathematics education has been slow to change. Given its "neutral" status and privileged position, change is often met with resistance, although there have been significant efforts to disrupt what and how we teach in the mathematics classroom. For example, in the past 2 decades and in the aftermath of testing policies pushed by governmental policy, there have been organizations and educators that have collaborated to work against high-stakes testing and promoted a more culturally responsive and socially democratic mathematics education (see, e.g., Greer et al., 2009; Gutstein & Peterson, 2013; Wagner & Stinson, 2012). Culturally responsive and critical pedagogies are significantly different approaches to mathematics teaching and learning than traditional pedagogies. The mathematics learner is perceived uniquely in each. In the traditional pedagogy, the mathematics learner must demonstrate their "ability" to think mathematically. They are seen as separate from the mathematics they are learning (Valero, 2004**)**. Culturally responsive and critical pedagogues perceive the mathematics learner as rooted within a mathematical culture and never separate from it (Greer et al., 2009). The mathematics taught in the classroom is shaped around this culture and the learner is valued for their differences and contributions. In general, the studies conducted on student–faculty interaction have not considered the pedagogical positioning of faculty, which can shape how they perceive the mathematics learner, and influences the interactions they have with students.

The methodologies used by researchers studying student–faculty interactions hold, for the most part, modernist[12] assumptions that the data under investigation mirrors a reality that can be fragmented and decontextualized so themes and theories can "emerge" via systematic analysis.

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[12] Modernist assumptions are often correlated with Enlightenment thinking. Enlightenment thinking is characterized as a state of being "that makes us accept someone else's authority to lead us in areas where the use of reason is called for" (Foucault, 1984, p. 34). One such assumption is that reality can be uncovered and known through reasoning.

Student–faculty interactions are conceptualized as an experience removed from reality and examined as independent of the acting, subjugated subject. I do not conceptualize student–faculty interactions in this way. I see interaction as an experience not removed from reality, but rather, embedded within it, even if only for a moment, and capturable by representation. Representation is interpreted and constructed. Here, the subject is influenced and constrained, perpetually re-written and re-made within discourses of power/knowledge and relations of power (see Foucault, 1982).

CHAPTER 3

THEORETICAL PERSPECTIVE

Mathematics teaching and learning and mathematics education research are "always already entangled" with and in ontological, epistemological, and ethical considerations that are either knowingly or unknowingly engaged throughout the research process (Stinson, 2020). My philosophical considerations on mathematics teaching and learning have changed throughout the years and remain flexible for future disruption. The possibilities and limitations of my research study were (and are) forever everywhere influenced by the theoretical framework I utilized and the philosophical considerations that I maintained. This study is located within a critical postmodern framework (see Stinson, 2009; Stinson & Bullock, 2012, 2015). Critical (e.g., Kincheloe & McLaren, 2011) and postmodern (e.g., St. Pierre, 2000) theories provided the necessary tools to explore how student–faculty interactions are historically, contextually, contingently, and politically situated, maintained, and reproduced through systems of power and power relations.

In this chapter, I revisit my philosophical considerations and discuss the specific theories that framed this study. I situate my theoretical positioning by providing a brief historical account of different possibilities for conducting mathematics education research. I describe my theoretical positioning by outlining two major theories: critical theory and postmodern theory. I then explain how their hybridity, a critical postmodern theory, informed this study on student–faculty interactions within the context of a critically transitive pedagogy.

Historical Mapping of Mathematics Education Research

Research in mathematics education began in the mid-1800s, primarily in university settings (Kilpatrick, 1992), where the "chief method of establishing legitimacy for the field was for researchers to align themselves with the existing epistemologies of mathematics and the developing theories of psychology" (Stinson & Walshaw, 2017, p. 129). The inferential science of psychology was instrumental in early mathematics education research because researchers could observe groups of students in controlled classroom settings and look for patterns of cognitive development. It assisted researchers in exploring how mathematical content was "best" taught and learned, and for the next century, topics such as IQ tests, gender differences, curriculum reform, and the effects of instructional treatment on student learning were examined. These early studies, however, are now understood as inadequate; data were limited because experiments were often conducted in lab-like classroom settings and theory was all but absent from inquiry. Mathematics education research grew nonetheless, and so did the demand for more consistent and sufficient data to predict student learning and "ability." Written tests, surveys, and lab-like classroom observations became sources for evaluation as students were measured and categorized so outcomes could be predicted. In fact, most social science research prior to the 1960s used quantitative methods and modernist assumptions to measure, evaluate, and predict human behavior (Paul & Marfo, 2001).

From the mid-1950s and well into the 1980s, mathematics education research focused merely on evaluation and policy research (Paul & Marfo, 2001). This focus placed a spotlight on curriculum and instruction and a flurry of activity on curriculum reform began in mathematics education, all while students were measured and evaluated based on perceived ability. In 1980, however, William Higginson proposed that mathematics education research be informed not only by mathematics and psychology but also by sociology and philosophy. Higginson argued that all intellectual activity is based on assumptions of a philosophical type, and mathematics education is no different (Stinson & Walshaw, 2017).

Prior to the 1980s, there was very little work in the philosophy of mathematics that was not mathematical in character (Ernest, 1998; Stinson & Walshaw, 2017). Most philosophies of mathematics attempted to provide prescriptive accounts of the nature of mathematics by discovering the absolute foundation of mathematical truth (Ernest, 1998; Stinson & Walshaw, 2017). These absolutist views encountered problems at the beginning of twentieth century when contradictions had formed in mathematics. These contradictions created a flaw in the assumption that mathematical knowledge had an absolute foundation of truth. Fallibilism[13] in the philosophy of mathematics was presented (Ernest, 1998).

Ludwig Wittgenstein (1889–1951) was an important philosopher during the early twentieth century who accepted the fallibility of mathematical knowledge (Ernest, 1998). Rather than assuming absolute foundations to mathematical truth, Wittgenstein located mathematical truth within the engagement of language games. According to Wittgenstein, mathematical knowledge is created by the agreement and rules of the accepted language games. Mathematical truth, then, is justified by its persuasiveness to abide by the accepted rules and norms, not by an absolute foundation. It is anchored in human practice.

Imre Lakatos (1922–1974) was another philosopher of mathematics who promoted fallibilism (Ernest, 1998). His philosophy describes mathematics as a historical social practice. He showed how mathematical concepts are contingent on a variety of circumstances and how the evolution of mathematical knowledge plays a central role in its philosophy. According to

[13] Fallibilism is the view that the justification of mathematical knowledge involves human agency and cannot be reduced to the objective conditions of knowledge (Ernest, 1998).

Lakatos's philosophy, mathematical truth is not considered absolute but rather it is established through social practices and human agency.

Although these early philosophers accepted fallibilism in mathematics, discussions of theory were nearly nonexistent in mathematics education research (Ernest, 1998; Stinson & Walshaw, 2017). When Higginson made the call to include philosophy and sociology in mathematics education research, scholars did just that. In 1984, a new Topic Study Group – Theory in Mathematics Education was organized at the 5th International Congress on Mathematical Education; the aim of the group was to promote self-reflection and "another way of thinking" within mathematics teaching and learning and mathematics education research (Stinson & Walshaw, 2012, p. 130). Through the next couple of decades, the outgrowth of this study group contributed to a broader analysis into mathematics education, which resulted in a proliferation of theory usage in mathematics education research. This proliferation in turn resulted in a proliferation of theoretical difference. To make sense of this theoretical difference, Stinson and Bullock (2012) provided a mapping of sorts of the historical moments and paradigms of inquiry within mathematics education research. In Table 1 (Stinson & Walshaw, 2017, p. 133) the moments are arranged more or less in chronological order, while the paradigms of inquiry illustrate some of the different theoretical and methodological possibilities within each moment. Stinson and Bullock emphasized that their mapping was not absolute but fragmented, shifting, disrupting, incomplete, and continually reconstituted. They encouraged researchers to be open to moving among the paradigms of inquiry and consider weaving through them as they think and rethink the possibilities and impossibilities of mathematics education research.

Table 1
Mapping Moments of Mathematics Education Research to Paradigms of Inquiry

- Process–Product Moment (1970s–)→**Predict**
- Interpretivist–Constructivist Moment (1980s–)→**Understand**
- Social-Turn Moment (mid 1980s–)→**Understand** (albeit, contextualized understanding) or **Emancipate** (or oscillate between the two)
- Sociopolitical-Turn Moment (2000s–)→**Emancipate** or **Deconstruct** (or oscillate between the two)

Paradigms of Inquiry				
Predict	**Understand**	**Emancipate**		**Deconstruct**
*Positivist	*Interpretivist	*Critical		*Poststructural/
Experimental	Social constructivist	<<Feminist>		Postmodern
Quasi-experimental	Radical constructivist	Critical Race Theory>		Postcritical
Mixed methods>	Sociocultural>	Latino/a Critical Race Theory>	*BREAK*	Postcolonial
	Phenomenological	Critical Theories of Race>		Posthumanist
	Ethnographic	<Participatory Action Research		Post-Freudian
	Symbolic Interaction	Critical Ethnography		<Discourse Analysis

Note. *Indicates the term most commonly used; < or > indicates cross-paradigm movement. The BREAK in the original Lather and St. Pierre table indicated a shift from the Enlightenment humanist paradigms on the left to the post-Enlightenment, posthumanist paradigm on the right. Here it indicates a hybrid, in-between space where the researcher might adopt a critical postmodern theoretical tradition (see Stinson & Bullock, 2012, 2015).

Paradigms of inquiry adapted from table by P. A. Lather and B. St. Pierre, 2005, found in "Paradigm Proliferation as a Good Thing to Think With: Teaching Research in Education as a Wild Profusion," by P. A. Lather, 2006, *International Journal of Qualitative Studies in Education*, 19(1), p. 37.

I grounded this study with theories that are located within the sociopolitical-turn paradigm. This moment appeared in the mathematics education research literature in the early 2000s when the larger mathematics education research community began to recognize mathematics knowledge as political, contextual, and constituted with and in sociopolitical discourses. Stinson and Walshaw (2017), drawing from the work of Gates and Vistro-Yu, described researchers whose work might be characterized as being in this moment as adopting "a degree of social consciousness and responsibility in their attempts to both understand and expose the wider social and political picture of mathematics and mathematics teaching and learning" (p. 134). Next, I discuss two foundational theories—critical theory and postmodern theory—that fall within this paradigm and how the hybrid, a critical postmodern theoretical framework, influenced my work. But first, I describe the setting and context of my theoretical positioning.

Theoretical Positioning

Traditional perspectives in the philosophy of mathematics focused on the objects of mathematics and the certainty of mathematical knowledge (Ernest, 2009). The objects of mathematics are “abstract, Platonic objects, existing in some possibly objective world” (p. 43). The assumed certainty of mathematical knowledge contributed to its objectivity, and it was perceived as a system free of influence. Yet throughout history, the nature and philosophy of mathematics have evolved, based on the needs of society. Renert and Davis (2010) outlined this evolution as they propose five major stages and discuss the nature and tools of mathematics within each stage. The stages are: (a) oral, (b) pre-formalist, (c) formalist, (d) hyper-formalist, and (e) post-formalist. The oral stage is located during the time before writing was invented. Here, mathematical meaning is found in experience, and objects in the environment act as mathematical tools. The invention of writing marked the pre-formalist stage, where people visualized mathematics using symbol systems. In this stage, mathematics is understood as a mode of reasoning in a natural world. Knowledge resides outside of the knower and was obtained through empirical observation. Then, emerging briefly in Ancient Greece, and then to full fruition during the time of Newton and Descartes, was the formalist stage. Mathematics is a distinct discipline in this stage, with a formal mode of reasoning. Formal logic, as described by Renert and Davis, “applied strict derivation rules to fundamental propositions, or axioms, in order to produce new mathematical results” (p. 182). Most of the practices in mathematics teaching and learning today reside in the pre-formalist and formalist stages, where mathematics is perceived as an abstract, formal mode of reasoning. Ernest (2009) described the limitations of this perspective and argued that mathematics consists of more than just abstract knowledge representations. Mathematics includes a broad range of human activities and knowledge-based practices.

The 20th century marked the beginning of the hyper-formalist stage. Renert and Davis (2009) explained that mathematics was reconstructed as a purely formal system during this time. Mathematical knowledge, Renert and Davis stated, only existed “to the extent that it [could] be derived within the logical parameters of the given formal system” (p. 183). In other words, it legitimized itself, and the notion of truth and validity were established based upon adherence to this system. The end of the 20th century marked the period when the limitations of these formal systems were interrogated, which cast mathematical certainty into doubt. Coined the post-formalist stage, here mathematics is understood as a socially constructed, interpreted discourse. The ideas of truth and validity, then, are also interpreted as social and discursive constructions. This stage is where my *current* pedagogical practices and perspectives reside.

I believe mathematics is a socially constructed, interpreted discourse. The perception of its neutrality and its objective status has been used socially and politically to reproduce and maintain social inequality. Furthermore, mathematics education has been a catalyst for the reproduction of inequality by linking mathematical success to economic success, then reproducing the narrative that schools should serve economic interests. This narrative is historically and politically situated. In 1983 the report *A Nation at Risk: The Imperative for Educational Reform* linked the quality of the U.S. education system to its economic standing (Rooks, 2017). More recent policies that contribute to this ideology include No Child Left

Behind[14] and Race to the Top,[15] where economic progress is correlated to student achievement in mathematics. Inequality is reproduced in mathematics education by the structures of schooling working under an ideology that equates mathematical success to the replication of specific, decontextualized procedures, by categorizing students based on their mathematical ability to perform these decontextualized procedures, and by excluding those who do not conform. Those who are excluded, then, are classified as economically un-deserved. These classifications, while existing under the narrative that schools provide access to economic success, govern the fabrication of the Homus Oeconomicus (Valero, 2018).

Homus Oeconomicus is a conception of a human being as an economic being (Valero, 2018). Consider the narrative that schools should serve economic interests. Then consider that students, within this narrative, are reconfigured in economic terms based on their testing performance. Students then become commodities in the work force, and economic growth is perceived as an increase in the supply of skilled human capital (deMarrais & LeCompte, 1999). The student is no longer a thinking being, but an *economic exchange* being. This idea that academic achievement actually matters for the economy highlights a particular way of thinking about the value of education. When education is valued this way, the issue, Valero (2018) explained, is that—

> we classify people with respect to how well they performed in tests, how well they sorted out a problem, and all these differentiations generate combined mechanisms of inclusion

[14] Signed into law in 2002 by President Georgie W. Bush, this bill required that by 2014, all public school children could perform at "grade level" as measured by standardized tests in the areas of reading and mathematics to remain economically competitive.

[15] In 2009, President Barack Obama announced this $4.5 billion grant that rewarded states at their efforts to collaborate with business leaders, expanded support for high-performing schools and standardized tests, and reinvigorated mathematics and science.

> and exclusion. We create a group of people whom we, in our practice, are giving and granting more value, while some are devalued. (p. 114)

Maintaining a post-formalist perception of mathematics not only helps me understand how the implicit assumptions of traditional mathematics teaching and learning can harm students in the broader social context but it also changes how the students and I engage with mathematics, and each other. Within this post-formal mathematics, students and I engage in more meaningful relationships because I devalue assignments that categorize and label them, influencing the interactions I have with them. For this study, I examined the interactions I had with students while implementing this type of pedagogy. This pedagogy, along with my experiences as an undergraduate mathematics faculty member and the positioning of my research participant—the self—contribute to the theoretical setting of this study. I discuss two major theories that constitute the eclectic theoretical (Stinson, 2009) positioning I used to examine her.

Critical Theory

In Stinson and Bullock's (2012) mapping of mathematics education research inquiry paradigms, critical theory resides in the emancipate paradigm of inquiry, where matters of domination, oppression, and emancipation are examined. In general, a critical social theory is concerned with issues of power and justice, and the ways that social institutions and cultural dynamics interact to construct a social system (Denzin & Lincoln, 2000). A central feature of this theory, explained by Ernest (1997), is to "engage in social critique and to promote social and institutional change to improve or reform aspects of social life" (p. 36). Critical theory is often considered to have originated during the 1920s. It was then that the Frankfurt School, associated with The Institute for Social Research, was founded (Bronner, 2011). Early members of the Frankfurt School provided the theoretical foundations of critical theory. Theorists such as Max

Horkheimer (1895–1973), Herbert Marcuse (1898–1979), Theodor Adorno (1903–1969), Jürgen Habermas (1929–) were major contributors in the early days of the school. These theorists were vastly different in their interests and intellectual strengths, although they did share some common commitments: human emancipation, to be set free from restrictions, to contest hegemony, and to remain skeptical about establishmentarian modes of thinking (Bronner, 2011). These critical theorists often shifted from the economic focus of Marxism and considered the cultural and political structures of society. They began to analyze mass culture and treat facts less as absolute truth and more as historical products of social action. Then, in 1942, Horkheimer and Adorno published the signature work of modern critical theory, *Dialectic of Enlightenment*. Bronner (2011) described the text as complex, with various interpretations, yet with certain indisputable features. These features, Bronner explained, "investigates how scientific (or instrumental) rationality expels freedom from the historical process and enables reification to penetrate every aspect of society" (p. 51). Modernity was repressively standardizing individuality and experience, creating intolerance to difference. The Frankfurt School became intent on challenging this culture.

Since these initial conceptualizations of critical theory, it has been used extensively in social science literature as a framework for inquiries on power and oppression (see Stinson & Walshaw, 2017). These inquiries take many forms and there is not a fixed set of characteristics for what critical theory is because it is constantly evolving. Although there is disagreement among critical theorists, there are some basic assumptions of critical theory that are agreed upon. Kincheloe, McLaren, and Steinberg (2011) cautiously provided these assumptions as—

- All thought is fundamentally mediated by power relations that are social and historically constituted;

- Facts can never be isolated from the domain of values or removed from some form of ideological inscription;
- The relationship between concept and object and between signifier and signified is never stable or fixed and is often mediated by the social relations of capitalist production and consumption;
- Language is central to the formation of subjectivity (conscious and unconscious awareness);
- Certain groups in any society and particular societies are privileged over others and, although the reasons for this privileging may vary widely, the oppression that characterizes contemporary societies is most forcefully reproduced when subordinates accept their social status as natural, necessary, or inevitable;
- Oppression has many faces and that focusing on only one form of oppression at the expense of others (e.g., class oppression versus racism) often eludes the interconnections among them; and finally
- Mainstream research practices are generally, although most often unwittingly, implicated in the reproduction of systems of class, race, and gender oppression. (p. 164)

Although critical theory has been around for decades, mathematics education research was not introduced to it as a theoretical tool and pedagogical possibility until the mid-1980s. Historically, there have been limited research studies conducted in undergraduate mathematics education that have prioritized critical theories on issues of equity and justice. Current researchers in the field who have employed critical theories have examined equity issues for Black students in face-to-face versus online mathematics instruction (see Jett, 2021), revealed racialized and gendered mechanisms operating in mathematics instruction (see Leyva et al., 2021), and highlighted racial disparities in the access of undergraduate mathematics resources (see Nishi, 2021).[16]

The dominant perception of mathematics up until the mid-1980s was that it was neutral, objective, and was the tool used to uncover reality. Mathematics was not perceived as a socially constructed discourse. Mathematics was a science, free from human influence, and free from power. Critical theorists challenged the modernist assumption that mathematics was neutral and free of influence and suggested instead that it acted as a tool to serve the interests of those in power. It was a power nurtured by capitalism (Bronner, 2011). While capitalism became the economic ideology for social functioning, the narrative which equated academic (mathematical) success to economic success was produced and normalized. Critical theory provided a lens to uncover the power and domination implicit within this narrative. For example, once mathematical success was linked to economic success, students were categorized based on their perceived mathematical ability; thus, their life's position in the structures and discourses of capitalism. Ability was reduced to replication of abstract information and articulated by quantitative scores on performance-based tests. Then, access to this abstract information was limited and controlled.[17] Critical frameworks explain how this power is maintained, and how dominant groups produce and reproduce it in schools via curriculum, methods of instruction, and modes of evaluation (deMarrais & LeCompte, 1999).

[16] The number of researchers who engage critical perspectives of mathematics and undergraduate mathematics teaching and learning has been growing over the past decade or so as illustrated by a perusal of the proceedings of the Mathematical Associate of America Special Interest Group – Research in Undergraduate Mathematics Education (RUME; see http://sigmaa.maa.org/rume/Site/Proceedings.html).

[17] Rooks (2017) provided a historical documentation of how quality education was limited and stolen from Black students, and how it continues today, to protect dominant White interests.

A general characterization to describe pedagogy grounded in critical frameworks is referred to as critical pedagogy. Critical pedagogy represents the theories and practices that push teachers and students to critically examine relationships between power, culture, ideology, and their interconnected social structures and discourses that produce and reproduce inequality (Leistyna & Woodrum, 1996). Critical pedagogy supports the empowerment of minoritized students and calls upon teachers to acknowledge the interconnecting relationships between the historical, cultural, and social influences that contribute to the production and maintenance of unequal power relations. (Darder et al., 2017; Stinson & Wager, 2012). Paulo Freire (1970/2000) is recognized as a major contributor to the development of critical pedagogy. Freire wrote about self-empowerment and social transformation, themes that are consistent with critical frameworks (Stinson & Wager, 2012). Freire promoted a humanizing education, one that encourages authentic thinking; that is, thinking that "is concerned about *reality*" (emphasis in original, p. 77).

Critical frameworks in mathematics education have led to movements such as teaching mathematics for social justice (see, e.g., Gutstein & Peterson, 2013; Wager & Stinson, 2012) and critical mathematics education (see, e.g., Frankenstein, 1983; Skovsmose 1985). Teaching mathematics for social justice is a growing body of research with two overarching pedagogical goals: social justice pedagogical goals and mathematics pedagogical goals[18] (Stinson & Walshaw, 2017). This framework promotes teaching mathematics in a way that empowers students to use it to challenge and confront social injustice (Freire, 1970/2000). Critical mathematics education promotes teaching mathematics so students can consider the social and

[18] Drawing from Gutstein, Stinson and Walshaw (2017) noted that social justice pedagogical goals include using mathematics to understand power relations and inequity; and mathematics pedagogical goals include using mathematics as a tool for empowerment, succeeding academically, and changing students' and teachers' orientation toward mathematics.

political dimensions of mathematics education (Valero, 2018). Valero explained this type of education as—

> a way to engage with questions such as what is mathematics in relation to society, what does mathematics do as part of the school curriculum, and what are the potentials of mathematics education to produce or challenge inequalities in society and among students. (p. 103)

A critically transitive pedagogy considers this type of education. Freire distinguishes three types of pedagogical transitivity: (a) intransitivity, (b) semi-transitivity, and (c) critical transitivity. Boyles (1998) described intransitive teachers as resistant to the idea that they can alter their pedagogy. They are aware of the problems around them but see no way to overcome them. Semi-transitive teachers embrace the idea that they can alter their pedagogy and address the problems surrounding them, but they work in the short term and do not address the root causes of the issues. An example would be when the Subject promoted tutoring programs to improve students' testing performance. The tutoring programs may have been beneficial for students in the short term, but the Subject did not address why testing performance had become so prioritized in the mathematics classroom. Critically transitive teachers address these social issues by using student experiences as vital components of the critique. Students are contributors in the classroom and take ownership in their learning because they are provided opportunities to connect their own mathematical experiences to a broader social problem.

Critical mathematics educators assume that learning mathematics will provide the tools needed to empower students (Valero, 2018). In critical mathematics education the mathematics learner is a social being with intention. The individual can decide if they want to engage with mathematical learning. Critical mathematics educators believe that students who decide to engage with mathematical learning will have a brighter future. In general, learning and engaging with mathematics represents a form of self-empowerment.

Critical theory provides the framework for my praxis. As I reflect upon my critically transitive pedagogy, I act upon it, then reflect again. This reflection – action – reflection … process creates a cycle where my pedagogy is always in flux, what Freire (1970/2000) termed praxis. Additionally, there are philosophical considerations in critical theory that cause me to weave between paradigms of inquiry for this study on the self (Stinson & Bullock, 2012; Stinson & Walshaw, 2017). The ontological assumptions of critical theory placed limitations on this study. My ontological perspective is that existence is fragmented, multiple, contingent, and becoming (Stinson, 2020). This perspective places the Subject[19] of inquiry within a "rhizome" (Deleuze & Guattari, 1980/1987). Reality for the Subject is not a linear progression of thought and action. The Subject is not a fixed, knowable being. Rather, reality is characterized as a web constructed by power relations that are always diverging, converging, and shifting; the Subject, then, is always diverging, converging, and shifting (Deleuze & Guattari). Critical theorists, however, position the subject of inquiry within historical realism. Historical realism views reality as constructed through discourses[20] of power (Stinson, 2020). For example, the discourses of hegemony, according to critical theorists, construct people as *objects*—those who are acted upon—rather than as *subjects*—those who act. Furthermore, critical theorists in mathematics education assume mathematical learning leads to a sense of self-empowerment. This conceptualization, however, represents a divided self. That is, a human-self and an ideal self—a

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[19] From here on out, I capitalize *Subject* when specifically referring to this unknowable perception of the Subject of inquiry—the self.

[20] Discourse in this context refers to the language, structures, signs, practices, and beliefs that maintain forms of social existence (Leistyna & Woodrum, 1996).

self to become, a self to uncover. I do not perceive self in this way. I perceive her as an acted-upon, always becoming self (Usher & Edwards, 1994). The Subject is not a dichotomized structure. She is multiple and fragmented. She is positioned in a web of merging, diverging, and intersecting moments that create meaning for her. Because the Subject of this study is this self, I needed another theory to ground my theoretical framework. I had to contend to my postmodern[21] considerations, not only for the positioning of the Subject but also to adopt an attitude to critique the traditional image of mathematics (Valero, 2004).

Postmodern Theory

Postmodernism emerged in the 1960s when critics began writing about the limitations of modernist thinking (Walshaw, 2011). Some of its major theorists include Jean-François Lyotard (1924–1998), Jacques Derrida (1930–2004), and Michel Foucault (1926–1984). Postmodernism is a blanket term used to characterize a variety of perspectives but most hold one tenet in common: the rejection of certainty (Ernest, 1997). Lyotard (1984) troubled the assumption that objectivity and certainty exist by examining the discourse of modernity. In the discourse of modernity, it is assumed that reality can be known when the human mind applies reasoning to uncover its assumed objective structures. This discourse dominated many areas of knowledge, including philosophy, physics, and mathematics, and from the time of the Enlightenment until the mid-1970s, most Western thinkers understood reality in this way (Ernest, 1997; Walshaw, 2004, 2011). Lyotard turned to language to explain how even the most fundamental legitimations to reason have no empirical foundation. Rather, reason uses itself to legitimize science, then science is used to legitimize reason, creating a cycle of self-legitimation. This cycle soon set a

[21] Postmodern is used in this context as a blanket term that encapsulates an “attitude of critique” (see Valero, 2004), incredulity toward grand narratives (see Lyotard, 1984), and questions of representation (see Derrida, 2007). Poststructural theory, often used interchangeably with postmodern theory, informs my work (see, e.g., St. Pierre 2000 and Walshaw 2001 for discussions on these terms differences).

standard that any kind of rationality not formed by science or reason was considered irrational (St. Pierre, 2000). Lyotard not only critiqued the discourse of modernity but also any claim to universal truth that serves to maintain the status quo (Usher & Edwards, 1994). Rather than a universal, objective truth, Lyotard reconceptualized truth as a bound system, constrained by the limits of language. Lyotard, however, also argued that the boundaries of this constructed system should not be ignored but rather understood as never established once and for all.

Derrida argued in his work that truth manifests in many unique forms. Usher and Edwards (1994) explained that for Derrida, “it is impossible to arrive at the *one* truth because there is always interpretation” (p. 120). Derrida (1966/2007) did not search for an absolute, unified truth. He argued it was impossible to reach, that interpretation would always interrupt. Interpretation is constructed through social and discursive representation, so it can never be independent of representation. This perspective puts forth the idea of a reality “constructed by representations and therefore of multiple perspectives where representations *become* reality and where reality is *always*, necessarily, represented” (Usher & Edwards, 1994, p. 14). Postmodernism also recognizes that this representation is not an independent neutral process. There is a *politics* of representation where cultural representation has a “complicity with power and domination,” and that all forms of representation are inescapably implicated with power (p. 15).

Foucault’s (e.g., 1982) work focused on inquiries in power and the making of the subject. He studied the emergence of modern institutions and the forms of governance associated with them, addressed the construction of modernity working within institutions (e.g., formal education), and revealed the power relations attached to knowledge, truth, and power[22] (Usher & Edwards, 1994). He was interested in moving beyond theories of power and studying the analytics of power. He did so by examining the constitution of subjects through discursive practices of knowledge/power.

Foucault (1982) described the goal of his work was "to create a history of the different modes by which, in our culture, human beings are made subjects" (p. 777). He described three modes of objectification that transforms humans into subjects. These include: (a) modes of inquiry that try to give themselves the status of sciences, (b) dividing practices, and (c) the way a person turns herself into a subject. Foucault was most interested in the latter. Through his analysis, he argued that the human subject has been placed in complex, subtle and hidden power relations. These power relations do not exist as power themselves, but rather, is a technique, a *form* of power. Foucault explained:

> This form of power applies itself to immediate everyday life which categorizes the individual, marks [her] by [her] own individuality, attaches [her] to [her] own identity, imposes a law of truth on [her] which [she] must recognize and which others have to recognize in [her]. It is a form of power which makes individuals subjects. (p. 781)

The subject is a representation, placed within a web of power relations, constituted through a bounded and influenced discourse. This discourse, according to Foucault, could never displace power relations, but it can reconfigure them.

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[22] Usher and Edwards (1994) explained Foucault's link of knowledge and power within educational institutions. Hidden behind modern discourse, the allusion is that "truth" and "knowledge" are only possible under conditions where power is *not* exercised. But knowledge is powerful precisely when it can lay claim to the status of truth. If this claim to truth is power, modernity's discourse of power, knowledge, and truth is brought into question. Rather than conceptualizing knowledge as possible under conditions where power is not exercised, Foucault reconceptualized power as always present and knowledge as discursively produced.

As I examined student–faculty interactions within the context of a critically transitive pedagogy, I assumed that the Subject of inquiry, the self, was positioned in a “rhizome” of power relations. This assumption diverges from modernist assumptions. Modernist assumptions position the subject in a logocentric position. When a subject is positioned in this way, Usher and Edwards (1994) suggested that it “implies that interpretation is about finding the source, origin or centre and hence the text’s singular truth and meaning—the one, deep and perhaps hidden meaning” (p. 127). Derrida (1966/1970), however, argued that there is no center, no absolute truth. That finding truth will always be a matter of interpretation, so truth itself is decentered, fragmented, becoming, and uncertain. A rejection of certainty relocates the centered human subject-of-modernity and replaces her with a decentered, acted-upon, and acting-within human subject-of-postmodernity. This subject is no longer external to truth, but rather, weaved into its infinite web. The decentered, human subject-of-postmodernity resides in a rhizome of a fragmented and becoming existence, constructed by power relations.

Davies (2010) further described the subject that exists in a world of modernist assumptions, which he called the subject-of-will. He explained, “The assumption of the subject-of-will is that who we are is accomplished through our own choices” (p. 55). The subject-of-will attempts to create an ideal image of self (ideal-self), separated from who they are (human-self), that can be uncovered with a rational mind. The separation creates boundaries and limits that differentiate the human-self from the ideal-self. Here, agency is considered a product of choice. The subject-of-will controls the meaning she makes. Davies however encouraged a different perspective of the subject of inquiry that challenges these modernist assumptions. His perspective assumes the subject is a “subject-of-thought” (p. 56). Within this perspective, the subject-of-thought does not control meanings, but instead, it is meanings that confines her (Usher

& Edwards, 1994). She is embedded within power relations that influence her possibilities of who she can *become* as they "*constrain* [her] in remarkably intricate ways" (Kincheloe et al., 2011). Postmodernism provides the tools to conceptualize a fragmented and multiple Subject embedded within power relations that influence who she is and what she can become. The Subject is perceived as an interpreted, re-written representation.

Critical Postmodern Theory

In mathematics education, critical postmodern theory offered a framework for studies working within the sociopolitical paradigm of inquiry in mathematics education (Stinson & Bullock, 2012, 2015; Stinson & Walshaw, 2017). Critical theory and postmodern theory are two different theoretical positions and hold some incongruency, but a hybrid critical postmodern theory helped me to think and rethink between the praxis of the critical and the uncertainty of the postmodern (Kincheloe & McLaren, 2011; Stinson & Bullock, 2012). Critical researchers adopt a degree of social awareness and use their scholarship to reveal and dismantle the power that produces and reproduces inequality in institutions, such as schools (Stinson & Bullock, 2012). Using a critical framework for this study provided conceptual tools to reveal how traditional mathematics ideology is harming many undergraduate students. I aim to use this research to promote social change and a *different* way of teaching mathematics (Ernest, 1997, Kincheloe et al, 2011)

By adopting a praxis of the critical, I had a responsibility to "zoom out" to explore the historical and sociopolitical discourses that shape the contexts (and possibilities) of my students and to "zoom in" to explore how these contexts influence their beliefs, values, motivations, experiences, and interactions (Stinson & Bullock, 2012). This back-and-forth process provided the context needed to better balance the unequal power relations that aided in the reproduction of inequality between the students and myself, leading to a more equitable space in the classroom, a desired outcome of a critically transitive pedagogy. Promoting an equitable space in the classroom requires that teachers value all students and support the development of their mathematical selves. The teacher must study the students so they can be better taught. Teachers must listen to what students are saying about their communities and the challenges they face so they can help students connect these challenges to a larger social, political, or cultural context to understand or solve them (Kincheloe et al., 2011). Removing a student from this context ignores the social construction of their mathematical self. When I engage in a critically transitive pedagogy, I use assignments where students must write about their mathematical experiences, values, and motivations. They explore their mathematical self and the experiences that contributed to its development. Not only do these assignments provide an opportunity to study the students, but the student is provided with an opportunity to examine the sociopolitical and cultural influences and experiences that shaped who they are. They begin to understand their mathematical self as a product of their life's positioning and less about their "ability" to think mathematically.

Kincheloe and colleagues (2011) provide suggestions for teachers to adopt a critical pedagogy. They explained that first critical teachers must "admit that they are in a position of authority and then demonstrate that authority in their actions in support of students" (p. 165). For example, when the Subject reflected on her position of authority in the classroom, she considered student grades to be an area rich with unequal power relations. In traditional courses, the teacher determines how student grades are calculated prior to the semester beginning. These standards are placed on a syllabus and presented to students early in the semester. Typically, the student receives this information and then decides if they will conform to it. If the student does not want to conform to the teacher's standards, it is an institutional policy that they may withdraw or transfer courses. The aim, however, was to balance the power relations between the student and the Subject. It was *her* standards that the students had to adhere to, and it was *her* standards that could change. Standards that confined students to what she offered them and made certain opportunities possible, while others were made impossible (Stinson & Bullock, 2012). To attend to the limits of traditional grading policies, the Subject broadened them and provided students an opportunity to contribute to course development, and specifically, to the grading standards. This change is not to suggest that the academic and mathematical standards she normally maintained were lessened. She just collaborated with the rest of the members of the course and placed more value on how the student learner wanted to be measured.

The positioning of the student learner was an important consideration for the Subject's critically transitive pedagogy. She considered her postmodern beliefs when she engaged with the mathematics student, whose positioning is determined by her own set of power relations and social pressures (Foucault, 1976/1990; Walshaw, 2001). She is constituted through experiences that are made available through complex and fluctuating discourses. This positioning of the student learner is different from modernist perspectives, where the student learner is perceived as separated from her experiences and her agency seeks to uncover her ideal self. With postmodern considerations, her agency is not about her ability to uncover her ideal self but about her awareness of the restrictions made on her. She is both "powerful and powerless depending on the terms in which her subjectivity is constituted" (Walshaw, 2001, p. 486). Using this perspective helps to reveal how students have been categorized and subjected by the discourses made available to them. Once students are aware of the discourse that has shaped who they are, they can dismantle the limits of their mathematical selves.

Valero (2004) questioned the dominant perspective of the student learner and proposed a "realized" perspective, where students have multiple motives for learning (p. 48). She suggested that teachers realize students have a type of agency. She explained that "students are participants in a social situation, and the development of that social situation depends strongly on the agency that they can exercise in it" (p. 48). Students who express their agency to engage with mathematics provide researchers with a perspective that considers intentionality[23] behind their participation. The students negotiate their engagement with the course based upon their perception of its relevance in relation to their intentionality. Empowerment takes place, Valero explained, "if students are agents and negotiation can help bring their intentions into the educational scene" (p. 49). Empowerment does not exist internally in mathematics, she continued, "but from the position that students adopt to influence the social practices where mathematics is taught and learned" (p. 49). It manifests from a power relation where a student can position themselves to influence the outcome of a situation. This perception of the student learner is different from traditional perspectives where the student is perceived as separated from the mathematics she learns and obtains empowerment through possession of it. Teaching within the context of a critically transitive pedagogy with these considerations, where a desired outcome is student self-empowerment, changes the mathematics classroom and my interactions with students in significant ways. The results of this perspective and the outcomes of it will be discussed in Chapter 5, but it offers evidence that critically transitive pedagogies provide a framework where more students engage with and learn mathematics, especially the many underrepresented students who have not benefitted from traditional methods.

[23] A rationale for engaging in learning (Valero, 2004).

Postmodern theories also provide the theoretical tools to explore how the Subject is constructed as a multiple, changing, confined self-in-context (Ernest, 2004; Walshaw, 2011). With this conceptualization, the constitution of self depends on the power relations she is embedded. Many studies that use postmodern theories employ Foucault-based frameworks to explore power relations; however, because Foucault's writings are fragmented, every researcher has their "own Foucault" (St. Pierre, 2004). For example, Kollosche (2016) presented his Foucault-based framework by positioning Foucauldian theoretical concepts as the analytical connections between representation of power, knowledge, and processes of subjectivation. St. Pierre (2004) used her interpretations of Foucault and found her theme *care of self* in her research. She described care of self as constructed through practice, situated in relation to codes of action and relationships to others. I used Foucault's theoretical concepts to examine how the Subject is confined and constituted; how she is made and re-made by her experiences, beliefs, and values; and how she has been positioned in power relations that form her context and shape her perceived self (Stinson, 2009).

Concluding Thoughts

The positioning of the Subject of my proposed inquiry—the self—is decentered. She is a subject-of-thought that creates and re-creates her world through this context. She is embedded within a "web of reality" maintained and influenced by power relations and understands them to always exist (Kincheloe et al. 2011). In this study, I captured a representation of an interpreted moment, interpreted by yet another representation, where meanings were made, remade, and re-remade. Throughout, I constructed an interpretation, a reinterpretation, a re-reinterpretation, … of the text.

In this chapter, I have offered my philosophical considerations and described the theoretical perspectives that framed this study and the foundational theoretical perspectives that guided my inquiry. As I explored student–faculty interactions within the context of a critically transitive pedagogy, I examined the power relations that confined and influenced the Subject, and thus, shaped her interactions. Because I understand truth to be multiple, where interpretation will always interrupt, my aim was not to arrive at a unified understanding. My aim was to explore and interpret moments in a complex web of power relations to describe my understanding of the social world of which I am a full member. To capture moments and explore perceptions, it was necessary to conduct an intimate study. In the following chapter, I describe the methodology I used to capture that intimacy.

CHAPTER 4

RESEARCH METHODOLOGY

A research methodology, as described by Ernest (1997), is a "*theory* of methods—the underlying theoretical framework and the set of epistemological (and ontological) assumptions that determine a way of viewing the world and, hence, that underpin the choice of research methods" (p. 35). As I conducted research, I understood the process as a situated activity. It consisted of interpretive practices that made the world visible, transformed the world, and turned it into a series of representations (Denzin & Lincoln, 2000). In this study, I used an analytic autoethnography to explore student–faculty interactions within the context of a critically transitive pedagogy. The chosen methodology for this study allowed me to consider the historical and social context of student–faculty interactions from the perspective of the self. In this chapter, I describe how conducting an analytic autoethnography provided me the capability to capture and represent these perceptions. I first describe the development of analytic autoethnography by summarizing the foundational methodologies it was derived from: ethnography and autoethnography. I then outline the research design and discuss the methods I used to collect and analyze the data. Finally, I describe the ethical considerations and the delimitations and limitations of this study.

What is Ethnography?

Ethnography, in general terms, is the study of culture. Early American ethnography grew from researcher's interest of the origins of culture and civilization of a people they perceived as "primitive" (Denzin & Lincoln, 2000). They studied the "American Indian" with the perspective of conquerors, and then this attention was diverted to immigrants who entered the United States during the industrialization period. From the 1900s to the 1960s, studies of the ethnic "other" proliferated, mostly from sociology and anthropology. Student sociologists often lived in the settings they studied, collected data, engaged with the community, but seldom maintained explicit and reflexive self-observation (Anderson, 2006). Then the gaze turned inward, and numerous students examined their workplaces and other settings where they were personally involved. Social scientists experimented with self-observation as some advocated for autobiographically situated and self-observant research (see Hayano, 1979; Zurcher, 1983). By the 1980s, contemporary ethnographers would frequently be members of the cultures that they studied. This membership led to postmodern considerations that emerged in the mid-1980s, where the researcher is assumed to do more than observe, they are participants in the research inquiry.

What is Autoethnograpy?

The study and writing of culture from the perspective of the self is referred to as an autoethnography (Bochner, 2000; Chang, 2008; Denzin, 2014; Hughes et al., 2012). Chang (2008) defined an autoethnography as an ethnographic research method that "utilizes the researcher's autobiographical data to analyze and interpret their cultural assumptions" (p. 9). As defined by Denzin (2014), autoethnography is "reflexively writing the self into and through the ethnographic text; isolating that space where memory, history, performance, and meaning intersect" (p. 22). Autoethnographies are self-narratives that extract meaning of life experiences (Bochner, 2000). They call to attention the researcher as a critically reflexive participant, thereby forcing a critical examination of the act of conducting research of the self in relation to one's community" (Hughes et al., 2012, p. 210). It is necessary to be visible in the research process and within the written text. This visibility is a central feature of autoethnography. As explained by Anderson (2006), the "researchers' own feelings and experiences are incorporated into the story and considered vital data for understanding the social world being observed" (p. 384). This visibility is maintained through transparency (Hughes et al., 2012). Hughes and colleagues (2012) classified autoethnographic scholarship as empirical research when it is warranted and transparent. Duran and colleagues (2006) explained:

> Reporting should make explicit the logic of inquiry and activities that led from the development of the initial interest, topic, problem, or research question; through the definition, collection, and analysis of data or empirical evidence; to the articulated outcomes of the study. Reporting that takes these principles into account permits scholars to understand one another's work, prepares that work for public scrutiny, and enables others to use that work. These standards are therefore intended to promote empirical research reporting that is warranted and transparent. (p. 212)

Autoethnography clarifies the purpose, problem, context, or issue being addressed by utilizing the self as a central subject of inquiry (Hughes et al, 2012). It should highlight the subject's "understanding of existing structures, theory, and scholarship" (p. 212). Chang (2008) warned however that "autoethnography is not about focusing on self alone, but about searching for understanding of others (culture/society) through self" (p. 49). It should connect to existing social theory to add to, refine, or diverge theoretically. With this sentiment in mind, I used Anderson's (2006) conceptualization of an *analytic* autoethnography to inform this study on student–faculty interactions.

What is Analytic Autoethnography?

Analytic autoethnography is a subset of autoethnography. The term *analytic* in analytic autoethnography, explained by Anderson (2006), "points to a broad set of data-transcending practices that are directed toward theoretical development, refinement, and extension" (p. 387).

Anderson outlined five key features of analytic autoethnography. The first key feature is complete member–researcher. The researcher must be a member of the community they are researching. There are two types: opportunistic and convert. I would be classified as an opportunistic autoethnographer; that is, my membership of the academic community precedes the decision to conduct research on the academic community I am a part of. Convert autoethnographers join the community after they decide to conduct research on them. The second key feature of an analytic autoethnography is analytic reflexivity. Kleinsasser (2009**)** described researcher reflexivity as a methodological process of learning about self as researcher, which, in turn, illuminates deeper, richer meanings about personal, theoretical, ethical, and epistemological aspects of the research question. He continued, “Researcher reflexivity creates physical evidence of personal and theoretical tracks through a created text, evidencing the researcher’s deep learning and unlearning” (p. 156). This process leads to the third feature of an analytic autoethnography: narrative visibility of the researcher self. Bochner (2000) described the purpose of the narrative:

> We narrate to make sense of experience over the course of time. Thus, narrative is our means of fashioning experience in language. Narrative is true to experience in the sense that experience presents itself in a poetic dimensionality saturated with possibilities of meaning, however perishable, momentary, and contingent. (p. 270)

As Bochner sees it, language will always bind and limit an experience saturated with possible meaning. Interpretation will always interrupt. We cannot come to know one true meaning of an experience because there are multiple.

In Anderson’s (2006) fourth feature, he argued that the researcher must dialogue with others. He claimed that author saturation in autoethnographic texts stems from failure to adequately engage with others. But an experience does not lose its meaning if it is not experienced in a specific way, that is, with others, adequately. Author saturation, rather, stems from overemphasis on narration rather than analysis and cultural interpretation (Chang, 2016). Vryan (2007) suggested that including data from and about others is not a necessary requirement of all analytic autoethnography. He explained that "the necessity, value, and feasibility of such data will vary according to the specifics of a given project and the goals of its creator(s)" (p. 406). Self and others, however, are not mutually exclusive. An autoethnography captures the self in relation to the other. Autoethnography, as stated by Chang (2016), "benefits greatly from the thought that self is an extension of community rather than that it is an independent, self-sufficient being, because the possibility of cultural self-analysis rests on an understanding that self is part of a cultural community" (p. 26). This perspective aligns with postmodern concerns that theory developed with modernist frames recognize self as an independent, self-sufficient being.

Resisting author saturation characterizes the last key feature Anderson (2006) outlined of an analytic autoethnography: commitment to theoretical analysis. Writing of self required an explicit examination of the Subject's sociological, philosophical, and epistemological positionings. These positionings helped me understand the construction of the Subject's assertions, and how power relations operated to shape them (Kincheloe & McLaren, 2011).

Research Design

Autoethnographers inquire by using an "inside-out" structure (Adams et al., 2015). For this study, I took an inward look into the Subject's own identity, beliefs, and experiences, then an outward look into culture and the relationships she had with others. As I looked inward, I examined influential moments that changed how she taught, what she believed, or what she valued. I constructed themes that made sense given my current conceptualizations of those moments. These moments are what Somerville (2007) coined the “postmodern emergence” (p. 225). Her methodology highlighted that moment when the self shifts, the “point of transformation” (p. 228). Somerville reconceptualized Glaser and Strauss’ 1967 grounded theory to consider its limitations, its emphasis on verification, and its modernist assumption of a centered truth. She explored the *space-of-becoming*, a liminal space where a self transitions from who they are to what they become. By locating these moments, I could highlight this liminal space and explore how it was connected to power. Looking outward, I examined how this connection influenced the interactions the Subject was having with students. Examining those connections provided an opportunity for me to recall her shifting perspectives and provide structure to the study. Gathering data to explore these elements required I remain flexible yet grounded in a thorough data collection plan that would provide a variety of different data.

Data Collection and Research Setting

One of the advantages of an analytic autoethnography was that as a complete member–researcher, I had an abundance of data on the Subject available right away. Course documents such as syllabi and student assignment submissions from previous courses were accessible on UWG’s online grade management system. I had documents saved on my home computer, such as research proposals and award applications that the Subject had written in earlier semesters, and I had all her writing from her coursework at GSU. I kept a researcher journal while I was teaching an undergraduate course during the spring 2022 semester and after the semester concluded, I interviewed 5 students and one colleague from that course. It was a precalculus course, and I chose this course because the Subject was already planning to make radical changes and teach it with a critically transitive pedagogy. It had been difficult to make any changes in the mathematics classroom prior to this point in time. Non-tenured faculty, the Subject included, overwhelmingly taught undergraduate mathematics courses, but they had little agency in the mathematics department due to their non-tenured status. Although some colleagues were supportive, change was often met with resistance. Then in 2020, UWG went through their reorganization and the Subject was placed in the newly formed Department of General Education in University College. Once she was placed in a new department, she was given support by her chair and dean to experiment pedagogically.

One radical change in the course came from working with a colleague in her new department who taught undergraduate English. The Subject had been experimenting with reading and writing assignments as course assessments and quickly realized the benefits students would have if they could develop their writing. The Subject and her colleague designed a collaborative[24] course, precalculus and English composition, where they used texts on culture to thematically link the disciplines. They also included assignments with narrative writing where students would explore and write about their own cultural identity, specifically, their mathematical identity. This type of assignment (discussed more in chapter 5) makes it easier to implement a critically transitive pedagogy.

Types of Data

Personal memory data.

Personal memory data, described by Chang (2008), "is a building block of autoethnography because the past gives a context to the present self and memory opens a door to the richness of the past" (p. 71). What is extracted from memory data is written down as textual data by chronicling the past, inventorying self, and visualizing self. In Chapter 1, I described past

[24] This course required that students enroll in my undergraduate mathematics course and my colleague's course during the same semester (i.e., the same students were enrolled in both courses).

experiences while the Subject was operating within a traditional perspective of mathematics teaching and learning, and the transformative moments that shifted her traditional perspective. This process helped me locate historical moments of transformation. I reflected on these moments and interrogated them, creating new memories from the old ones.

There are considerations to take when collecting and analyzing memory data. Fournillier (2017) made these considerations when reflecting on her 2005 research study where she explored mas' makers' perceptions of the art of Carnival mas' art. As Fournillier returned to her images, interviews, field notes, literature reviews, articles, and representations of her findings, she described feeling "continued tensions between what I remember about what I did, what I believe I should have done, and the ethical implications of memory work" (p. 493). When Fournillier used memory work as a method of inquiry, she noted how her own positioning shaped her considerations. Who she read and studied, and how she applied theory, all allowed her to re-write the experience, and re-write her past self. Postmodernism uses theoretical constructs that already assume the self is re-written, and as I used memory data to locate meaning, I reflected on Fournillier's considerations as I re-wrote the Subject. When representing my re-written self, I remain transparent in what I remember the Subject did, what I believe she should have done, and the tension this differentiation created. This differentiation was a diverging moment within her web of power relations, where meaning is made. Recall, the subject-of-thought does not control these meanings. Instead, it is this meaning that confines her (Usher & Edwards, 1994). It is at these diverging and intersecting moments where her perceptions, values, and beliefs are shaped.

Self-reflective data.

Self-reflective data represents perspectives of moments after introspection (Chang, 2008). I collected two types of self-reflective data: reflections of past self and a research journal. When

I reflected on the Subject's past self, I used personal memory data to guide my introspection. Syllabi from six semesters, all precalculus courses, were used to provide structure to this self. The syllabi provided an opportunity to interrogate the Subject's past beliefs and locate shifts in her perspective of mathematics teaching and learning. I also used memory data to explore the context of the Subject's past self and reflect on moments of transformation that impacted her interactions with students.

According to Ortlipp (2008), keeping a self-reflective journal is a strategy that can facilitate reflexivity by exploring assumptions, goals, values, and beliefs. During the spring 2022 semester, I kept a researcher journal where I highlighted interactions, moods, and thoughts the Subject had experienced while interacting with students. I did not write in the journal immediately after an interaction. The thoughts that I recorded in the journal were written at the end of the day. This created additional distance between the Subject's interactions with her students and my recollection of it.

External data.

External data, according to Chang (2008), "provide additional perspectives and contextual information to help you investigate and examine your subjectivity" (p. 103). External data I collected include various published reports, published course documents, and personally produced texts, such as award applications or research proposals. Some of this external data was included in Chapter 1. Additional data is included in Chapter 5.

Interviews are also characterized as external data. Chang (2008) suggested interviews in an autoethnography are useful for various reasons: to "stimulate your memory, to fill in gaps in information, to gather new information about you and other relevant topics, to validate your personal data, and to gain others' perspectives on you" (p. 106). After receiving approval from the Institutional Review Board and GSU, I conducted interviews with one colleague and 5 former students, interviewing each once for less than one hour. The unstructured student interviews were conducted in my office during the fall 2022 semester, and the interview with my colleague was conducted off-campus in a private location after fall 2022 semester ended, during the holiday break. I asked the participants to describe their experience in the mathematics course and the interview evolved from there. I wanted to interview my colleague because she had observed this undergraduate mathematics course several times that semester and witnessed interactions the Subject had with students. The interview with her and the interviews with students provided another perspective to consider. The interviews were valuable when I took an outward look into the relationships and experiences that were influential for the Subject. The interviews also aided in my researcher reflexivity so I could connect my personal beliefs and values to the social and theoretical aspects of my research question (Kleinsasser, 2009).

To recruit students for the interview, I sent an email to all students who were enrolled in the undergraduate mathematics course (see Appendix I). The email was sent to their university student account during Fall 2022. I asked my colleague directly if she would be willing to participate, and after receiving confirmation, I sent her the same email as the students. Five students responded and I included all 5 in the interview process. The students were a diverse group, 3 men and 2 women. Three students were Black, one was White, and one LatinX student. All were traditional college-aged students in their late teens or early twenties. Three students were majoring in STEM, one majoring in education, and one majoring in psychology. For confidentiality, and because I was not conducting research on my students but rather on the interactions I had with them, I combined their multiple voices into a singular identity for the purpose of representing them through this text. I refer to these 5 students as Student1. My colleague will be referred to as Colleague1. My colleague is a White woman who has been teaching undergraduate courses for almost a decade.

All interviews were recorded except for one student interview. During this particular interview I was unaware my recording device was not working, thinking I hit the right button. Immediately after, I realized my blunder and wrote down what I remembered about the session. For the remaining recorded interviews, I stored the files on my password protected home computer. I listened to each interview once and located timestamps where I or students spoke about interactions, relationships, and opinions on mathematics and mathematics teaching and learning. I listened to the recordings a second time, located the timestamps in the audio, and typed a non-verbatim transcription for each participant.

Secondary data.

When the Subject engaged in a critically transitive pedagogy for the Spring 2022 Precalculus course, she used writing as a method of student learning. There were 89 unique reflections from 15 different students (including the 5 students who participated in the interviews) that were submitted for course assignments. These writings were personal, and to protect the students' confidentiality, I also combined their voices into a singular identity for the purpose of representing them through this text. Student1 is separate from this identity, which I refer to as Student2.

The work students submitted for the writing assignments were a goldmine of useful information, but what they wrote also influenced the Subject's interactions with them during the semester. The assignments prompted students to engage with their mathematical identity and share past experiences. By doing so, they shared personal information that helped her build relationships with them and get to know them in a different way than she would through regular conversation.

Data Considerations

Data management.

Data management is a link between data collection and data analysis. Chang (2008) advised that data be managed as it is being collected. I followed this suggestion by labeling and classifying data as I collected it and made a note of initial ideas and interpretations that I had. All data were stored on my password protected computer or on UWG's online grade management system. As I analyzed data, I printed hardcopies of writings and interview transcriptions to make notes, which are stored in a locked cabinet in my home office.

As I collected and organized data simultaneously, I was able to refine it more effectively. Data refinement, as defined by Chang (2008), "is a process of narrowing the focus of data collection and furthering data analysis by trimming redundant and less important data and expanding more relevant and significant data" (p. 119).

Data analysis.

Data analysis, as described by Stinson and Bullock (2012)**,** is a two-part process: a "zooming out" and "zooming in" again (p. 42). They noted that by zooming out "researchers begin to see the interactions that might occur between and among teachers, students, and mathematics as being rooted in concentric contexts" (p. 44). By zooming in, researchers can "explore the dynamic complexities of how socio-cultural and historical discourses have constructed and continuously shape teachers, students, and mathematics as subjects of inquiry" (p. 44). Zooming in and examining the context of the Subject was uncomfortable and intrusive, but it was a necessary part of data analysis. Feeling discomfort when examining or revealing her past self indicates that a change had occurred, or a perspective had shifted. If that self was no longer a part of the Subject's identity, then there was influence in her divergence. I identified and explored those influences to analyze the data.

I used traditional methods to interpret and analyze my data. Although I maintain postmodern considerations and was reluctant to construct common themes in the data, I made the decision to use familiar methods because of my limited experience conducting research. I used a latent approach of a theoretical thematic analysis to examine the data (Braune & Clarke, 2006). A thematic analysis guided my interpretation of the multiple aspects of student–faculty interactions by providing the tools to identify, analyze, and report patterns within and across all data. A theoretical thematic analysis is driven by the researcher's own interests in the research area and can be used to examine how a theme plays out across all data. For this study, I used the Subject's interest in student–faculty interactions to explore how it plays out in her web of reality. I sought to identify the underlying assumptions and ideologies that gave the data particular forms and meaning. This process describes a latent approach to a theoretical thematic analysis.

One of the benefits of using thematic analysis is its flexibility (Braune & Clarke, 2006). I had a variety of data types that warranted this flexibility. Although Braune and Clarke offered a six-phase process for conducting a thematic analysis, this process is not linear. The phases they outline are to: (a) familiarize yourself with the data, (b) generate initial codes, (c) search for themes, (d) review themes, (e) define and name themes, and (f) produce the report. As I familiarized myself with one set of data, I was coding and developing themes for another. Each data set was examined individually, then themes were grouped together and revised for an overarching theme in the data. Once overarching themes were constructed, I could interrogate the Subject's past beliefs and perspectives by using personal memory data and self-reflective data to identify moments when there was a divergence. It is at these divergences that something influential exists, producing a shift from previous thought.

Personal memory data and self-reflective data already had a familiar quality to it. I used the Subject's course syllabi and previous writings to guide my introspection and explore her past self. The course syllabi provided a historical narrative of her values as a mathematics instructor. I used the syllabi to identify when her language toward and about the student learner changed or when she made pedagogical transformations. For each syllabus I reviewed, I extracted these identifiers and organized them chronologically. For the student and colleague interviews, I listened to each audio recording once and marked timestamps where the participants or I articulated a verbal utterance related to student–faculty interactions, education, or experiences from the course. Secondary data also had a somewhat familiar quality to it because they were student assignments from previous semesters that the Subject had already read and graded. During the course, students would upload their writing to the online grade management system, so I had access to all their original reflections. I printed all these reflections and sorted them based on assignment type.

In phase 2 of a theoretical thematic analysis is generating initial codes. Codes are a feature in the data that I found interesting or meaningful. In phase 3 I searched for themes in the codes, condensing where possible. Beginning with participant interviews, I listened to the interviews a second time and coded each timestamp. I reviewed the coded timestamps and typed a verbatim transcription of those moments. Table 2 summarizes the codes I developed for the participant interviews.

Table 2
Initial codes for participant interviews

Code	Description of code
Lens	Participants describe their opinion on traditional or non-traditional mathematics education
Testing	Participants describe their opinion on mathematics testing
Support	Participants describe characteristics or experiences that appear supportive
Confidence	Participants describe their confidence in mathematics
Community	Participants describe a social aspect of the course

The themes for the self-reflexive data were broad although I focused my analysis on moments where the Subject described her own perspectives or beliefs. I extracted quotes and sorted them based on date and grouped them according to theme. Table 3 summarizes the themes and their descriptions.

Table 3
Themes for Self-Reflexive Data

Theme	Description of theme
Engagement	The Subject described student engagement
Interacting	The Subject described interacting with students
Bonding moment	The Subject described moments with students that I felt made us closer

For the secondary data, course assignments asked for the student to reflect on their mathematics identity and experiences. When reviewing what the students wrote, I developed general themes and extracted verbatim quotes that referred to the themes. I organized the quotes by theme and labeled where the quote originated and who wrote it. Table 4 summarizes the themes and their descriptions.

After I constructed themes for each data set, I was ready to review and refine them. I studied the coded data, combined themes, and determined each theme’s validity based upon its relevance to the whole data set. By the end of this process, I had a sound idea of the overarching themes in the data, and I used them in conjunction with my personal memory data to interrogate the Subject.

Table 4
Themes for Secondary Data

Theme	Description of theme
Identity	Students described some aspect of their self
Relationships	Students described a relationship they had with a teacher
Past experiences	Students described a past experience involving mathematics
Perspective	Students described their perspective of mathematics education
Anxiety	Students described having mathematical anxiety

Reliability and Validity

For this study, I used verification strategies to ensure reliability and validity of the data to maintain high standards of rigor (Morse et al., 2002). These verification strategies helped me to identify when I should refine my data, modify the research process, or stop the process completely. It was a constructive practice that occurred during all phases of the research.

One verification strategy that Morse and colleagues (2002) suggest will ensure rigor is methodological coherence. I sought methodological coherence by aligning the framework to this study parallel to my own philosophical and epistemological beliefs. As I collected and interpreted data, I had the ability to collect additional data on the Subject as she described her experiences interacting with students, providing an opportunity for a more thorough analysis. As I interpreted the data, I referred to my research question, *how does the Subject describe interacting with students within the context of a critically transitive pedagogy?* to guide my inquiry. I used the question to refine my data as I collected and analyzed it concurrently, all while I remained committed to theoretical thinking and theory development (Morse et al., 2012).

Ethical Considerations of Analytic Autoethnography

Maintaining confidentiality of my participants and students was a priority in this study. Their names are replaced with pseudonyms and any markers that could identify them were modified or removed. Neyland (2004) informed other ethical considerations of my research methodology. He advocated for a rejection of the modern approach to ethics, which is “based on the assumption that ethical-self-regulation results from the formulation, by those in authority, of ethical-legal code that people find reasonable to follow” (p. 56). I therefore do not follow a script for ethics, nor do I rely on an ad hoc evaluation of my ethical standards. I instead prioritize and maintain an ethical self. This ethical self, Neyland explained, “shifts the primary focus of morality away from answering to the demands of an ethical code and onto answering to either the demand of the other person who needs me, or to that of my own moral self-consciousness” (p. 60). What Neyland suggested was an ethics, not as a set of rules or procedures, but an ethics *for* the other person, a “primordial, reality of self” (p. 58); that is, an ethical self that acknowledges the social bond as its foundation. Conducting ethics in this way shifts the focus away from procedural compliance and forces the researcher to maintain an awareness of ethical issues as the research is happening and attend to them in the moment. The ethical self prioritizes the protection of the other.

Methodological Limitations and Delimitations

The limitations and delimitations of a study characterize the factors that influence the results or interpretations of a study. Limitations are outside of the researcher’s control, while delimitations have some control of the researcher and describe the scope of the study (Baron, 2008). With an analytic autoethnography grounded in a critical postmodern frame, the limitations were abundant. This study was a highly contextual project so there are several unique factors that influenced the outcomes and conclusions. One major factor was the research setting. UWG is a diverse, public, comprehensive university where the Subject teaches undergraduate courses that almost all students must take. The university has almost 2:1 ratio of women to men. In Fall 2022, the composition of the student body by gender was 8,078 female students, and 3,386 male students. Table 5 summarizes the Fall 2022 composition of UWG student body by race/ethnicity.

Table 5
Fall 2022 Composition of UWG Student Body

Race/Ethnicity	Number of students
Black or African American	3,668
American Indian or Alaskan Native	19
Asian	206
Native Hawaiian or Other Pacific Islander	10
Caucasian/White	6,398
Hispanic/Latino	909
Two or more races	479
Unknown/not reported	225

The Subject's courses are representative of the student body demographics. The diversity provides opportunities where students can provide multiple perspectives, contributions, and skills into the learning experience. The setting is ideal for student learning (Page, 2008; Chang, 2006, 2001).

Another limitation was the privileged position that I maintain at UWG, as I have been employed there for over a decade. The opportunity that I was given to experiment pedagogically in my courses would typically not be awarded to a non-tenure track faculty member, but the circumstances that surrounded me and UWG produced an opportunity where this was made possible. UWG is also a place where I have felt supported by my colleagues. I am privileged to be surrounded by caring educators who are committed to students and their learning. Receiving support from colleagues throughout the years has kept me motivated to participate in pedagogical and personal development. They have been mentors, collaborators, and friends. The support given to me by administrators at UWG motivated me to be creative and was necessary for any pedagogical transformations to occur. Furthermore, the support of my dean, department chair, director of freshman mathematics, and colleagues contributed to this context. Without this support, the radical changes that I have made in the classroom would not have been achieved.

When I began collecting data in spring 2022, I began the semester with the intention of collecting data from all the Subject's students, but this was deemed difficult because of the number of students she teaches. There are classes still where she uses a traditional pedagogy because of the time commitment required of a critically transitive pedagogy, so I thought the differing approaches would be interesting to look at, but it was too much. I decided early on to refine my approach and only collect data from the one course where she was implementing a critically transitive pedagogy.

Obtaining fieldwork was also difficult. I had planned to keep a field journal and write about the Subject's interactions with students as they happened in the moment. As a complete member–researcher, it was difficult to execute the multiple positions. The Subject could not become teacher self and researcher self at the same moment. Often, students spoke to her before or after class, in succession. Reporting those interactions as they happened would negatively impact her teacher self because she could not give students her full attention when they interacted with her. I therefore was not able to collect data in the field, but I reflected on these interactions at a later time and described them in my researcher journal.

Concluding Thoughts

In this chapter, I described the research methodology that frames this study on student–faculty interactions within the context of a critically transitive pedagogy. I outlined the research design by summarizing the type of data I collected and how I analyzed it. I described my ethical considerations and discussed the limitations and delimitations of the study. Using an analytic autoethnography framed in a critical postmodern lens provided tools to examine the beliefs, values, and perspectives of the Subject. I was able to explore a phenomenon that is highly contextual and shaped by socio-political and cultural influences.

CHAPTER 5

DATA REPRESENTATION, INTERPRETATION, AND ANALYSIS

Before I began the process of data collection, interpretation, and analysis, I thought about how I would represent the Subject, and what to include about her. I had made a habit of saving all my past work documents and course writings, so I had an abundance of information that could provide context for the Subject, but what was appropriate? Could I represent the Subject's re-written self accurately? Would it even really matter how I represent the Subject because interpretation will always interrupt? (Derrida (1966/2007). If it does not really matter, then could I represent her as being whomever I wanted? Tempting, but it would be inaccurate to think that anything goes because of these tensions with representation. Rather, I conceptualize the Subject as a multiple, fragmented, and an always-becoming representation (Ernest, 2004; Stinson, 2020; Usher & Edwards, 1994; Walshaw, 2011). A captured, changing self I attempt to represent as I see her in a moment, reflected upon and written about. My aim is to represent the Subject honestly, making explicit my logic of inquiry as I study her (Duran et al., 2006). But the logic of inquiry was not neat. It was a chaotic and messy cycle that led to more questions than the one research question I used for analysis: *How does the Subject describe interacting with students within the context of a critically transitive pedagogy?*

I used this research question as a starting point, a guide into my inquiry. The purpose of this question was not to answer it, but to explore the context surrounding it to reveal the power relations that influenced the Subject. To summarize, I began with the journal entries the Subject had written over the spring 2022 semester and used the research question as a lens into her perceptions, beliefs, experiences, and values. I extracted quotes where the Subject described interacting with her students and revealed that engagement was a characteristic of students that she often wrote about, indicating it was something she valued. To further investigate the characteristics that she valued in students, I conducted a document analysis on her previous course syllabi (Ezzy, 2002). This analysis helped me capture transformations in her pedagogy over time, providing an opportunity to reflect and write about them. Upon closer look at the pedagogical transformations, I realized that the Subject's perception of the student learner had also transformed. These transformations occurred after she had been provided with the opportunity to broaden her understanding of teaching and learning mathematics, revealing that her perceptions were confined by the discourse available to her (Kincheloe et al., 2011; St. Pierre, 2000; Usher & Edwards, 1994).

With these transformations in mind, I examined the Subject's self to explore them further. During this process, I sought to be specific and personal (Ezzy, 2002). I used personal memory data to rewrite and contextualize a past self, as I saw her in the moment. I experienced multiple tensions during this process. It was uncomfortable and placed the Subject in vulnerable positions, but this interrogation is a necessary feature of an autoethnography. The Subject's own experiences and perspectives must be incorporated into the research process as vital data to understand the social world she is a member of (Anderson, 2006). Some memories that caused tension represented a divergence from who she was to who she is now. It is what Somerville (2007) characterized as the space-of-becoming. I explored this space, albeit begrudgingly, to consider the influences and power relations that may have caused the transformations to occur.

After I spent time examining course syllabi, reflecting, and writing, I began to understand that the pedagogical positioning of the Subject was an important consideration in this study. The Subject is a non-tenured faculty member at UWG who teaches undergraduate mathematics. I was able to locate the Subject's pedagogical positioning by examining what she valued in the mathematics classroom, how she perceived the student learner, and how those perceptions may have changed over time. I have located her current pedagogical positioning within a critically transitive pedagogy, where the overarching aims are to prioritize ethics and value all students. During data analysis, I found that the Subject's pedagogical positioning provided the blueprints for her perception of the student learner, influencing the power relations between her and them (St. Pierre, 2000). Power relations are rooted within a system of social networks (Foucault, 1982; Usher & Edwards, 1994). It is a human relationship, always present, where the exercise of power, according to Foucault, "consists in guiding the possibility of conduct and putting in order the possible outcome" (p. 789). It is exercised by controlling the conduct of another. In this study, I found that these power relations operated when the Subject confined (or supported) a student's mathematical self.

In this chapter, I describe the pedagogical positioning of the Subject by highlighting how she diverges from the traditional practices of mathematics teaching and learning. I provide details on her current pedagogical positioning and summarize the various assignments she used to meet the aims of it. After describing the Subject's pedagogical positioning, I offer further context by summarizing how she perceives her multiple selves (Ernest, 2004). Then I provide details of my data analysis and logic of inquiry (Duran et al., 2006).

The Pedagogical Positioning of the Subject

In the Subject's critically transitive pedagogy, mathematics is understood as a socially constructed, interpreted discourse (Ernest, 2009; Renert & Davis, 2009). It is bounded and confined by language, and although mathematics consists of stable and enduring rules and patterns, it is subject to change and is not separate from human interpretation (Derrida (1966/2007; Ernest, 2004; Usher & Edwards, 1994). Traditional mathematics is often perceived as a fixed science free from influence, so pedagogy usually ignores the socio-political and cultural aspects of it. Traditional mathematics teaching, therefore, is mostly the teaching and learning of mathematical identities and procedures. A common curriculum is regularly used among schools to aim for coherency and unity, and at UWG, the Subject is still required to teach specific concepts in all her courses and administer common assessments. Ernest (2004) highlighted the contradictions of this perspective by describing the fluid nature of school mathematics, along with the fluid nature of mathematical research topics:

> Just as there is no essence to mathematics itself, so too there is no essence to school mathematics or to mathematical research topics. Boundaries change as elements from one division of school mathematics are absorbed and reconstituted into another, for different contexts and different periods of time. There is partial overlap between different topics—some are learned in parallel, and others develop and extend topics met earlier in study. The name may remain the same, but this is convention and convenience. The underlying processes and entities are all the while shifting and changing. (pp. 18–19)

In other words, it is an illusion that mathematics is a fixed science, and this illusion has stifled innovation and creativity. If the goal is unity, exclusions would be undesired, but where the exclusions occur is where innovation is found. Innovation is change, a divergence from the traditional. This divergence is not to say that learning the rigid procedures and formulas of mathematics should be eliminated in the mathematics classroom. That omission would leave little room for important mathematical concepts. Instead, the goal of teaching mathematics should transition from a goal of unity (i.e., common assessments, standardized curriculum, measuring students equally) to a goal that supports each student's unique mathematical self. This goal could provide educators with the space to teach mathematics with equitable opportunities for all students.

In every mathematics classroom, each student exists in their own web of reality with certain values, beliefs, and experiences that influence their relationship with mathematics. They construct a mathematical self, but when something goes wrong in the formation of this self, Ernest (2004) explained, “negative attitudes and dispositions toward mathematics seem to result, which may or may not interact with other identities being formed” (p. 30). In most mathematics classrooms, if students do not know or cannot retain procedures of specific mathematics topics at a specific time, then they are oftentimes portrayed as unprepared, unmotivated, or unskilled. This label remains with them until the student conforms and stifles their own unique relationship with mathematics, or they create a mathematical self that accepts this label and gets branded as a “bad” student of mathematics. When a student must stifle her own mathematical self in favor of maintaining the standardized discourse of mathematics, she is also subjectifying herself by constructing a bounded and confined identity as mathematical subject (Ernest). She is stripped of her autonomy and has little authority in the development of her mathematical self. Furthermore, she is isolated, measured, and categorized, and then subjected by that categorization (Foucault, 1982; St. Pierre, 2000; Walshaw, 2011). She is constructed based upon what is available to her. She is, St. Pierre (2004) argued, “a subject that exhibits agency as [she] constructs [herself] by taking up available discourses and cultural practices and a subject that, at the same time, is subjected, forced into subjectivity by those same discourses and practices” (p. 502).

Traditional mathematics research typically portrays the student learner as a universal, normal student, separate from the mathematics she is learning, and most research has been conducted to understand how she thinks mathematically (Valero, 2004). This portrayal of the student learner, Valero claimed, represents a "divided self—one that has to do with mathematics and the other has to do with other unrelated things" (p. 41). Her mathematical self is an abstract, universal, and context-free human being, detached from experience and detached from her other, unrelated self. Valero promoted a different way to conceptualize the student learner. She suggested "realizing" students as full members of a larger society, who have "multiple motives for learning, and who live in a broad context which influences their intentions to participate in school mathematics practices" (p. 48). Valero argued that when trying to understand the mathematical learning experience of students, their socio-political and cultural contexts cannot be discarded.

In a critically transitive pedagogy, the Subject shifts from traditional conceptualizations of mathematics pedagogy while holding a perspective of the student learner that Valero (2004) suggested. The student learner has multiple selves that can converge in one moment and diverge in another to form a context-dependent mathematical self with multiple motives for learning. Confining students' mathematical selves to only their ability to replicate procedure on a common, timed assessment is not promoting equitable opportunities for each student to nurture their relationship with mathematics.

In efforts to diverge from traditional goals in a mathematics classroom, the Subject placed more value on course assignments that provided students with the opportunity to nurture this relationship and have more autonomy in the development of their mathematical self. I summarize some of these course assignments below. The Subject created and used these specific course assignments during the Spring 2022 Precalculus course. These assignments contributed to the aims of a critically transitive pedagogy because they provided opportunities for the Subject to value students and prioritize their well-being.

Course Assignments

Course assignments consisted of in-class and out-of-class activities. In-class activities focused on the procedures and applications of mathematical concepts. A strategy for the in-class assignments was to maintain a balance of the familiar and non-familiar, of traditional and non-traditional activities. The Subject used traditional lectures, asked students to spend time practicing the procedures, or asked students to work together to solve a challenging problem. Group activities were common. Her intention was to promote learning as a social activity and provide opportunities for students to engage in more complicated mathematics by working with others. She highlighted the multiple approaches that the students took when working through mathematical applications and encouraged students to recognize and appreciate this difference.

Classroom activities also included assignments that explored mathematical topics from different cultures. The Subject used modified activities from Barta and colleagues' (2014) *Math is a Verb* to provide students with the opportunity to engage in a culture-specific activity of the Navajo and Brazilian cultures. The activities helped students to connect the procedures and techniques of the different cultures to the procedures and techniques of their own. By engaging in this type of activity, students could conceptualize mathematics as a social construction and broaden their understanding of it. They notice their own conceptualizations are dependent on their own culture and social positioning.

Assignments that students worked on outside of class consisted mostly of writing assignments. Writing in the undergraduate mathematics classroom is rare (Finkenstaedt-Quinn et al, 2022), but it is not a new teaching practice for U.S. public K–12 education. The *Principles and Standards* of the National Council of Teachers of Mathematics (NCTM, 2000) encouraged teachers to teach students how to communicate their mathematical reasoning coherently. Writing has been used as a natural vehicle to communicate that reasoning. Most of the studies conducted on writing in the mathematics classroom have used it as a form of data to either provide insight on student thought or to investigate if students better understand mathematics with the use of writing (Jepson, 2005). The writing assignments that the Subject used were not designed to assess and measure student learning. They were designed so students could explore their mathematical selves, nurture their relationship with mathematics, and conceptualize mathematics as a social human activity (Kincheloe et al, 2011; Renert & Davis, 2009). There were two types of major writing assignments in the course: narrative biographies and annotated bibliographies.

The narrative biographies were designed for students to understand how their social and cultural positioning influenced the development of their mathematical self. Students explored their mathematical selves by reflecting and writing about their own positioning in their web of reality (Ernest, 2004). They reflected and wrote about past experiences, values, and beliefs in mathematics, revealing to them how their mathematical self has been influenced and confined, and they realize that this self is not fixed and rigid but can be changed based upon their positioning (Kincheloe et al., 2011; St. Pierre, 2000; Usher & Edwards, 1994; Walshaw, 2001). There were 3 narrative assignments in the course. Each narrative had one of the following prompts:

1. Describe your experience(s) in mathematics.
2. Describe your ability to engage with and be successful in mathematics.
3. Describe your beliefs about the utility, value, and significance of mathematics in relation to your personal and cultural identity.

The narrative biographies also provided the Subject with the opportunity to get “to know” the students so she could better humanize and connect with them (Freire, 1970/2000**).** Humanizing the students, re-attaching them to their mathematical selves, and valuing what they present provides a kind of support that encourages the students to nurture their relationship to mathematics and push the limits of their mathematical self.

Annotated bibliographies were the second major writing assignment in the course. The annotated bibliographies were a part of a larger creative project. Students were asked to choose a research topic they were interested in and describe how it is connected to mathematics. Students located, read, and studied three separate sources that related to their topic. The Subject asked students to summarize the sources and write a reflection that promoted their own thoughts and ideas on what they read and how they understood it to be mathematically related. For the remainder of the creative project, students created a presentation on what they learned using the sources they found and presented their topic to either the class, or at the 2022 General Education Conference at UWG. This type of project provided an opportunity for students to make their own mathematical connections by highlighting the mathematics contained in their research topic. It also gave the Subject the opportunity to value the students' unique contributions to the mathematics they were learning.

In the Spring 2022 Precalculus course, the students submitted their writing on the online grade management system where the Subject could print them off and give written feedback. For this study, I returned to those submissions and reprinted what the students wrote as data. I use student quotes from these writing assignments in this text. Quotes that have been extracted from student writing are represented throughout this text verbatim.

The writing assignments, with a brief description, and their classification, are outlined in Table 3 below. I use this classification throughout the chapter to indicate what course assignment a student quote was extracted from.

Table 6
Writing assignments with their description and classification

Writing Assignments	Description	Classification
Narrative Biographies	Students wrote about their belief in the value and significance of mathematics in relation to their cultural and personal identity.	NV
	Students wrote about their experiences in the mathematics classroom.	NE
	Students wrote about their belief in their ability to engage and be successful with mathematics.	NA
Annotated Bibliographies	Students located, studied, and wrote a summary and reflection on 3 sources related to a research topic of their choosing, highlighting mathematical connections.	AB

Other data that are represented verbatim throughout include all the Subject's prior writings and teaching documents. The Subject's journal entries that are included have been edited and paraphrased slightly for grammar and clarity. Data were also collected on one colleague and 5 students from the precalculus course held during the spring 2022 semester. The Subject's colleague sat in on several of the class meetings and witnessed in-class interactions that she had with students. She is characterized throughout this chapter as Colleague1. The five students, whose identity I combined into one, are characterized as Student1. Combining the students into a singular identity is not to promote the idea that the students were identical, nor am I trying to describe a universal student. I combined identities because it protects the students' confidentiality and because I am not conducting a study specifically on these students. The remaining students in the course are characterized as Student2. Interviews were conducted on Colleague1 and Student1. Interviews represented are paraphrased for clarity or grammar. There will be multiple quotes from Student1 and Student2 that carry the same message. Multiple quotes that carry the same message originate from different students but will use the same characterization. I do not use multiple quotes from the same student to promote a similar message.

Throughout this text, I represent the Subject as a construct of multiplicity (Ernest, 2004). She is a fragmented set of selves-in-context who has multiple and changing identities that may converge in one moment and diverge in another (Ernest, 2004; Usher & Edwards, 1994). The Subject is not an isolated self, where she is a separate person within each context. The Subject's self is a construction she creates in the moment based upon her positioning, constituted by perceptions, beliefs, and experiences, all while confined and limited within the discourse available to her. I examined moments where the Subject's multiple selves converged in the classroom and explored how her own perceptions, beliefs, and experiences influenced the interactions she was having with students. I describe some of these moments below and provide the context of them.

The Subject's Selves

I struggled with deciding how much personal information I should include about the Subject. I had tried writing about her personal past self before. Right after the spring 2022 semester, I tried writing about her as a young adult, revealing a difficult past, but I marked it as too personal for this study and filed it away. The second time I tried to write about her was specifically for this chapter. I had written an essay full of disclosures of a self I was hesitant to expose. Regretfully, I deleted it and wrote over it soon after. A quick decision I knew I should not make, but in a moment of insecurity, I erased that representation. I could justify my avoidance of representing this self by suggesting she had nothing to do with this study, or that she was in the past and far removed from the self I am exploring now, but that would go against my own beliefs. I cannot remove her from a past that has shaped who she is in the present and future (Ernest, 2004; Walshaw, 2011). Disclosing this past can capture how her multiple selves converged in the classroom, influencing her interactions with students, but this is still a self I do not want to expose in detail, so I offer a compromise. I returned to the Subject's journal entry that I marked too personal and extracted highlights of the Subject's personal past.

As I read through these highlights and recalled the memories, I accepted the discomfort and moved forward. I am not comfortable sharing these memories, even a small glimpse, but they are important to the Subject's journey. I begin with memories from 2009 when she was 27 years old, after college and living at home with her parents:

> …with no job, dealing with untreated depression, and coping with it by drinking, drugs, and taking pills…
>
> I didn't know how to deal with these emotions. Usually, I would withhold anything negative that happened to me; it was easier to control other peoples' reactions that way.
>
> I took responsibility, including that night, and my unhealthy coping mechanisms certainly did not go away.
>
> It gave me hope to start working again, and a chance to pull myself out of a dark hole. Then it happened. During one sunny afternoon in early September 2009…
>
> I just held him; it was all I knew how to do. The paramedics arrived and took over as I stood there and watched. The following week I had my first panic attack.
> I was controlled by my symptoms. They dictated what I could do and what I could feel. I held onto the trauma of that experience for over a decade, all while teaching undergraduate mathematics.
>
> In May 2021, I began to heal. I could feel my body change. Tears poured from my eyes, but I felt relief. I felt calm. I let go of the irrational perceptions I tightly held onto. I was finally unstuck.

For over ten years, the Subject was constrained and controlled by her personal trauma. One singular event transformed the Subject's self, and for over ten years, she endured relentless panic attacks. What she could experience and how she interacted with others were all affected by her mental health. A couple of years after her panic attacks had started to occur, she began teaching at UWG. She focused primarily on content development for work and put little effort into nurturing social relationships.

After ten years and with the help of a licensed specialist, one singular event transformed the Subject's self again. This event occurred while she was teaching at UWG and enrolled at GSU. She wrote about her experience and what led her to this transformation:

> In May 2021, my husband and I took a long weekend trip to North Carolina. We were driving there instead of flying, which was intentionally planned. Travelling had become difficult for me by that point. I had to restrict where I went and how I got there. For the past 4 years my panic attacks had been escalating. I was having so many of them, and they controlled so much of what I could do. I avoided anything that could be a potential trigger like crowds, and loud or busy places. I had been noticing that my body would heat up, especially my arms, when it started. Then the nausea would hit, and it would just keep getting worse until it became a full panic attack. It had gotten so bad that medication would not even cut through it. I would experience hours of my legs shaking, nausea and vomiting, and having a feeling of fear and panic overwhelm me. When I had a panic attack it would last for hours, but it happened in waves, so I had moments of relief; however, those moments did not last very long. My husband had learned how to manage these situations so I could be comforted in some way, but I usually just had to endure it and wait it out. Then, it would just all stop at once, and I would be left feeling exhausted both mentally and physically. On our trip to North Carolina, we stopped to eat and right after getting back on the road, I could feel my body change. I could feel it about to

> happen. I warned my husband and we drove on the interstate for as long as we could, hoping we could get as close to our destination as possible. Once it became too much (right after I vomited out the passenger window on a passing BMW), we pulled into a gas station. This incident was not unusual for my husband. He had spent hours in gas station parking lots with me before. Sitting in the car helped, being still helped, and being able to get out and walk around helped. Bathrooms were also close by. We had been at the gas station for about an hour when it just stopped. The nausea stopped, the fear and panic dissipated, and it was over. We got back on the road and arrived at our destination two hours later. The entire day after we arrived, I spent hovering on the edge of being ok and having another panic attack. We came home a day early. After returning, I met with my therapist whom I began seeing a few months prior. She suggested we have a session of EMDR (eye movement desensitizing and reprocessing) that day. In our session, we focused on one of the traumatic experiences I had in 2009. I had never really talked about this experience with anybody, but after learning about EMDR and how the body holds onto trauma, I knew it was the culprit of my panic attacks. It was obvious. I started having panic attacks a week after it happened. I responded well to the therapy session that day. It has helped more than anything else had. The trauma I experienced in 2009 and was still holding onto was released that day, and I felt it. During the session, my release was through tears. They just kept pouring from my eyes, but it felt comforting. I felt released that day, and I noticed that week later, my body even felt different. (May, 2023)

The Subject grew up in Arkansas in a small town with a population of about 6,000 people. Everybody knew everybody here and she had a huge family on her father’s side. Her second cousin, Sister Henrietta Hockle OSB (1927–2014) wrote a book for the family entitled

History of the Henry Thielemier Family: *1877–2008*, where she documented the family's genealogy. She wrote that Henry Thielemier came to America in 1881 when he was four years old. He arrived with his parents, Bernhard and Anna (Kline) Thielemeier.[25] They resided in Ohio and had two more sons. After facing hardship and the loss of her husband Bernhard, Anna was encouraged by a missionary priest, Father Eugene Weibel, to move to northeast Arkansas, where land was cheap. She settled in Arkansas and married Joe Brunner, who had land in east Pocahontas, Arkansas. They had four more sons. Henry married Mary (Weisenbach) in 1903 at the age of 26 at St. John's Church in Pocahontas, Arkansas. They had ten children, including Sister Henrietta and the Subject's grandfather, Frank Thielemier (1911–2011). Farming the land in Pocahontas was how the Thielemier family made a living. The Subject grew up in Pocahontas, where her father farmed crops of beans, rice, and wheat, mostly. Her father inherited a small amount of land from the Subject's grandfather Frank, who had nine children with the Subject's grandmother Josephine (Pfeffer). A few in the family turned to farming, but they each ran their own operation. The Subject's father stayed busy. He has built a successful business over the years, but farmers work hard with long hours. He has always provided for her family and although they did not have a lot of money while she was growing up, they never went without food, clothing, a home, or education. Her mother took care of the house and the four children. There was a decade spanning between the oldest sister and the baby of the family, the Subject.

The small town the Subject grew up in had a private Catholic school, and there were so many people in that small town who were Catholic that it could easily keep its doors open, and still does. Her family is religious and has roots in Catholicism, so her parents paid the monthly tuition so that all four of them could go to the school. The school was only K–6 grades when she

[25] Records show that the original spelling had an extra vowel.

was enrolled, but she received an education that many others do not have the privilege of accessing. Classes were small. Each grade had a cohort of about 20 students, on average. She was deemed a "smart" child and got so much joy from receiving the gold ribbons the school would pass out when students made all A's. She had a lot of green ribbons too, which were all A's and B's. She wrote about this experience, explaining:

> I do not think it was so much making the grades that brought me joy, but I liked collecting the ribbons, and they brought accolades from adults. It brought positive attention, and I liked feeling good about something that I did. Although being considered a "smart" student had its benefits, I would have been devastated if I did not get a ribbon, and there were plenty of students at the school not getting ribbons. (May, 2022)

The Subject had been labeled and categorized as a "smart" child, and she could recall when students would be divided during class based on their "ability" when learning certain subjects. This type of categorization is a mode of objectification that transforms humans into subjects (Foucault, 1982). Foucault described this process as *dividing practices*. He explained that the way people construct their identity is through processes of classification and division. People then make judgements of others based on where they are positioned in a previously established categorization. Some of the students in the 2022 precalculus course wrote about how these judgements in their past schooling stuck with them:

> From a young age, I was labeled as "almost gifted." This was due to the fact that no matter how hard I tried, my mathematical process was not to the standard of being what people call "gifted." This held a pretty impactful place in my head for a while, it was as if nothing really mattered unless I was in that top scoring group. Keeping in mind that by this time I was only right at 6 or 7 years old, it shows how early on our society starts demanding things from students. As I progressed in my education, the label of being "almost" or "not quite" stuck with me. (Student1, NE)

> My first memory in a math class was when I was 9 years old. I was sitting with my head in my arms staring at my dirt coated black and white converse, knowing my cheeks are

> red because of the light burn that was radiating from my skin. Tears clouded up my vision and confusion surrounded my thoughts. I was struggling to learn what triangle was what. These words like isosceles were completely foreign to me. From there I was stamped with the preconceived notion that I was not good at math. (Student2, NE)

> When going through school I was always told that I was "good" at math and that I would be a great teacher of math because I was good at it. My teachers would always encourage us to work together on assignments before we went to the teacher for help so I would always have a herd of students by my desk. (Student2, NE).

These writings reveal that the labels and categorizations placed on a student influence her own perception of her mathematical self. She constructs this self based on what has been made available to her, and she is confined and controlled by the judgements placed on her. This construction can converge and influence other selves that she may construct (Ernest, 2004). I considered how my Subject's multiple selves converge in the classroom and influence each other. The Subject wrote about one such convergence:

> On bad days, the smell of food triggered my anxiety. Lunchtime was especially difficult as we lined up single file to wait for the food being served that day. I usually brought my own lunch, except on pizza day, but I still had to wait in line with the other students. I recall one afternoon while waiting, I started to feel queasy, so I ran to the bathroom, hunched over, and heaved until something came up. It helped. The butterflies would occasionally go away when this happened. My teacher scared me when she walked in the bathroom that day. I was not expecting it. I was sitting quietly in the stall with the door open, waiting for my stomach to settle. She walked in but kept her distance. She started scolding me, a six-year-old, because she assumed I was faking it. I remember being confused in that moment. Could she not see I was sitting on the floor next to the toilet? Why did she think I was lying? After her scolding, she told me to come give her a hug. A confusing request from somebody who had just been so mad at me, but I did it. This

experience is one example of an interaction that convinced me to hide my distress. I hated getting into trouble.

My kindergarten teacher was not the only person who did not understand anxiety. There was not much information about it in the late 1980s, or if there was, the doctors in my small town did not know much about it. But I have certainly dealt with severe anxiety since my earliest memories. I had no idea how to manage it at such a young age. People would get angry about it, often thinking I was doing it on purpose or for attention. But the last thing I wanted was to be seen. I just wanted to escape my emotions and stop the symptoms, consisting mostly of fear, nausea, and vomiting. I understand the frustration others had. Some things that were not a big deal, like going to the movies, could trigger my anxiety, and it did not make sense to people that I would have so much fear over something that was so harmless. I did not understand it either, but I had to endure it. I remember once we had a Christmas play at the school where each class performed different dances in front of a crowd of parents. I had not been nervous leading up to the event, until I got into my classroom. It hit me hard. I ran to the bathroom when we entered the auditorium while the others took their seat on the bleachers. As the other classes were dancing, I was in the bathroom dealing with waves of fear and nausea, begging to myself, sobbing, that…please, I wish I would just die. I was eight years old. When it was time for my class to do our dance, I walked out and performed in front of that crowd. (May, 2022)

Avoiding situations that caused the Subject anxiety was regularly her solution. If she could not avoid them, she would just deal with the panic, deal with the fear and the nausea, deal with the anticipation and the obsessing until the event passed. The anxiety took away her ability to experience a lot in life. She could not enjoy moments or events while she was anxious because it consumed and debilitated her. She experienced it throughout her K–6 education, and it continued for the next few years when she transferred to the town's only public school. Once she hit high school, she developed more friendships and her anxiety started to feel like it was getting better. She still avoided a lot of social events. She never attended a school dance or high school football game, but that does not mean she was not a social person. It is just that instead of football games and proms, she was drinking wine coolers and taking shots of cheap tequila with her friends on the country backroads. At sixteen, she looked older than she was, and with confidence and a fake ID, she had no problem buying alcohol. She kept good grades though and graduated in the top ten percent of her class. She knew her anxiety would limit her college choices, and she decided to attend the local community college for 2 years then transfer to Arkansas State University, a mere hour drive from her home. Although she felt limited in her choices and avoided a lot of events because of her anxiety, she was hopeful that as she continued to grow older, her anxiety would continue to get better. She was wrong.

The experiences the Subject had with anxiety help her understand and empathize with students who also deal with anxiety, a common condition in the mathematics classroom (Ashcraft, 2002). Ashcraft defined mathematics anxiety as “a feeling of tension, apprehension, or fear that interferes with math performance” (p. 181). Mathematics anxiety begins to develop in children as young as five years old, and it affects about 50% of the U.S. population. Anxiety was a serious issue for several of the students in the spring 2022 precalculus course:

> I get really anxious. When it comes to tests, I get really anxious, but I know the information. But when I get anxious I forget, or I second guess myself. (Student1, interview).

> The main thing I've experienced in math is anxiety while testing, asking questions, and participating. (Student2, NE).

> As one who struggles with anxiety and a high probability of testing anxiety too, I relate to this a lot. (Student2, AB).

Boaler (2012) identified mathematics tests as a direct cause of anxiety. Ashcraft (2002) argued that individuals who suffer from mathematics anxiety not only have a strong tendency to avoid it and have low confidence, but they may experience cognitive consequences while taking mathematics tests. Their cognitive processes could experience an interruption that prevents these processes from fully executing. Ashcraft promoted this idea by using Eysenck and Calvo's 1992 processing efficiency theory. Ashcraft explained,

> In this theory, general anxiety is hypothesized to disrupt ongoing working memory processes because anxious individuals devote attention to their intrusive thoughts and worries, rather than the task at hand. (p. 183)

According to Ashcraft's theory (2002), if a student experiences anxiety during a test, their cognitive processes are interrupted, potentially resulting in poor test performance. Because of these poor test grades, these students are labeled negatively and are told they need to change something about themselves. Some students in precalculus wrote about their thoughts on testing, or the affect it has had on them:

> When I took algebra, it was very rough. Everything was more test-based and, almost like memorization, which I feel like did leave me to think that I'm not as good as other people are at math. (Student1, interview)

> Looking back, I remember the first test I took in Algebra II. I was terrified because all the memorization and everything. There was a point where I wrote down a formula on my hand, and…I don't know…. (Student1, interview)

> The moment after a test was over, anything that I had studied from the test went out of my head. I no longer had a use for the information that I was cramming just moments before. This led me to dislike math. Not because I didn't find the subject interesting, but because it was a temporary requirement that I didn't find important. (Student2, NV)

> I think really it would've been me in nursing, but once I took that exam, it just took me away from it. Even my mom, she was like, you were really set on doing the nursing, and I'm like, I know, but I shouldn't have failed cause I did everything right, but yeah, it really, it took me away from it. (Student1, interview)

> I find that a lot of our education system focuses more on preparing students for the next test rather than aiming to provide deep understandings of the subject matter. (Student2, AB)

Considering Ashcraft's theory (2002), it would be inappropriate to use mathematics testing alone to fairly measure students' cognitive "ability." Yet, testing is typically the primary tool of measuring students' cognitive "ability", and for most of her career, the Subject has taught courses where she used it as a primary tool.

The Subject has taught undergraduate mathematics for 14 years, most of which have occurred at UWG. She was introduced to teaching in 2005, where she taught developmental algebra as part of her graduate assistantship at ASU in Jonesboro, Arkansas. Developmental algebra was a non-credit bearing course taken by students who did not meet the testing standards to be placed in the credit-bearing core course, college algebra. During this time, the Subject decided teaching would not be something that she would continue after graduating. She struggled connecting to students and had a hard time understanding why some of them were failing the course. She taught students the exact same way mathematical content had been taught to her. She lectured, making sure she provided detailed and accurate notes on mathematical procedures. Students came to class, took notes, practiced problem sets, and ideally, would pass the tests. When students did not perform up to par, she placed most of the blame on them. Those assumptions influenced her behavior and led to student evaluations that suggested she should gain some people skills.

In August 2007, the Subject graduated with a Master of Science degree in Mathematics from ASU. She did not pursue teaching but found the current job market to be so unwelcoming to a new graduate student of mathematics, that 2 years later she accepted an adjunct position at her local community college. Unsure of what to expect when she began, she soon realized things were different this time. She was a bit older, and she had more engagement with students outside of class. These changes led to a better experience overall, and she became better at adjusting to the social space. She enjoyed teaching at the community college and accepted another adjunct position. After a couple of years teaching in Arkansas, she moved to Georgia and accepted a job at UWG.

When the Subject began teaching at UWG, she followed traditional methods. She used timed, in-class tests and quizzes for student grades, but she also had large lecture classes her first few years, so any other means of measuring student learning was not realistic. It was difficult to provide feedback for each student, and there was little class discussion happening. The structure was not an issue though. She taught mathematics primarily through lecture anyway. As time progressed, class size became smaller, and she experimented with course assignments. She implemented tutoring programs, attended teaching development workshops, and presented at conferences. Then after enrolling at GSU, her theoretical perspectives, beliefs, and values shifted. Her pedagogy shifted, and how she perceived the student learner transformed.

For this study of self, I conducted an analytic autoethnography to capture how the Subject describes interacting with students within the context of a critically transitive pedagogy. Through this process, I examined her values and beliefs through time, capturing transformations in how she perceived and interacted with the student learner. The Subject’s pedagogical positioning provided the blueprints for her perception of the student learner, in turn guiding the power relations between them and influencing their interactions (St. Pierre, 2000). Power was exercised when the Subject confined (or supported) a student's mathematical self. Below, I journey through this logic of inquiry by providing the details of my data analysis.

Data Analysis

Data interpretation began in summer 2022 when I conducted an inductive thematic analysis with all the writing from the precalculus students of that prior semester (Ezzy, 2002). The purpose of initially conducting a thematic analysis was not for this study specifically, but a colleague and I were scheduled to present at the August 2022 Lilly Conference in Asheville, North Carolina, on our interdisciplinary course design, which included a reporting of the Spring 2022 Precalculus class, and we wanted to include data for our presentation. From the data set, I had 95 student reflections available to code. I developed codes as I read through each reflection, going back through each student's writing several times. I extracted quotes and sorted them based on a code or codes. The initial codes were further combined into two major themes. Table 3 shows the initial codes and themes that I developed.

Table 7
Codes and Themes for Inductive Thematic Analysis of Student Reflections

Initial Codes	Themes
Mindset	Self-Efficacy Teacher Relationships
Confidence/ability	
Perspective of mathematics education	
Anxiety	
Motivation	
Teacher Relationships	

During the conference, my colleague and I focused on presenting the collaborative course design, and revealed that the positive and negative interactions that students had with their teachers affected them, evidenced in their own writing:

> Sadly, this is not my first time taking precalculus. I had similar experiences to my childhood last semester with a teacher who weirdly reminded me of my father in the sense that no matter the effort I was not good enough. Having those feelings brought back

> was a shock to me. I hated myself again. I had to sever my connection with friends just to fail. (Student1, NE)
>
> This teacher had impacted my thoughts on math negatively so much that I had taken myself out of the precalculus class the next year and went for the easier statistical reasoning class. In doing that, I had not been challenged in that class and did not learn much. That teacher did not seem to care too much if the students learned or not, and every day in that class we would just sit there on our phones or talk to each other instead of learning. (Student2, NE)
>
> Mr. Brown was a very dedicated teacher, he formed bonds with the students and thoroughly explained assignments, homework and the curriculum being taught to us. (Student2, NE)
>
> Every week I sat in my room drowning in these numbers he had given us just to be laughed at once class came the next day. I had grown weary and no longer felt the need to attend his class. (Student1, NE)
>
> I also believe that teachers influence children's lives more than most realize because of all the time that kids spend in the classroom. There should be a bond that the teacher has with their students…. (Student2, NE)

The students' reflections provide supporting evidence that the interactions between student and faculty, both good and bad, influenced their own perception of their ability and desire to engage with and be successful in mathematics (Kim & Sax, 2017). This finding is tied directly to the second theme in the data of self-efficacy. My colleague and I spoke mostly on self-efficacy during our presentation. In general, about half of the students who enrolled in the course began the semester believing that their mathematical abilities were poor or lacking in some way. Others felt their abilities were good, or their abilities have evolved over time. Toward the end of the semester, students were asked to write a narrative about their beliefs in their ability to engage with and be successful in mathematics. Below are extracted quotes from each student enrolled in the course:

- I believe I can do anything I put my mind to.
- I must fail to learn, and practice more in being more confident with myself, to succeed in math.
- …now I have started to break these barriers.

- Now after taking your class I do believe that I am good at math, I just think that I take a little longer to learn than others but there is nothing wrong with that.
- I think that anyone is capable of learning any math topic.
- I know I'm willing to put in the work to succeed and do what I need to do.
- …believing in myself has also boosted my ability to be a successful student in mathematics.
- I need to believe in my abilities and stop second-guessing myself because if I want to do it, I can do it.
- …one is only good enough if they put enough effort into trying or asking for help.
- I felt crushed but determined.
- …it is all psychological. I tell myself now that I can do it and I believe in myself.
- …so I knew I had to try…I'll never not try.

Collectively, these quotes provide evidence that students in that course articulated a renewed confidence of sorts in their ability to engage with and be successful in mathematics at the semester's end.

A few months after our presentation at the Lilly conference, I gathered my analysis and all the data to begin sorting through what I had collected. I sat for a while, not knowing where to begin in the mess I had in front of me. I considered the study was on self, so I located the data that was purely self-created. The journal entries the Subject had written over the spring 2022 semester contained her perceptions and experiences interacting with students. I recalled collecting this data. I had tried keeping a field journal but found it difficult with the Subject's chaotic days, so I wrote at the end of the day. All journal entries were reflections of past moments, an interpretation of a memory. I let my research question *How does the Subject describe interacting with students within the context of a critically transitive pedagogy?* guide my inquiry. I coded the moments in the Subject's writing where she described interacting with a student or how she perceived an interaction with a student. I extracted and organized the written quotes, sorting based on code and entry date. I located links in the codes and combined them into larger themes. When I coded the journal entries, I quickly noticed how often she would write the word engage, or some form of it:

> My first day of teaching was yesterday. Precalculus was engaged and participated with course development. (January 11, 2022)
>
> Their engagement earned them the point! (January 25, 2022)
>
> The other students got nowhere near this answer, but they all engaged with it, and were on the right track. (February 11, 2022)
>
> Students paid attention in lecture today. They were very engaged. (February 13, 2022)
>
> This week has been a rollercoaster ride. Monday seemed to be a day where students struggled to engage, but Wednesday felt the complete opposite. (March 31, 2022)
>
> It is what it is. At least the students are engaged. (April 5, 2022)
>
> I'm feeling good about their progress. They seem to be engaged with this. (April 12, 2022)
>
> Again, they're engaged. (April 14, 2022)
>
> That level of engagement is pretty remarkable. (April 22, 2022)

Engagement has been identified as a key to addressing problems of low achievement and alienation among students. There are several studies that provide supporting evidence that link student engagement with higher achievement and greater educational attainment (Fredericks et al., 2004; Putwain & Wood, 2003). Other studies provide evidence to suggest that students' interaction with faculty is central in shaping their engagement, which influences their decision to remain enrolled (Attard, 2011; Cole & Griffin, 2013; Hayes et. al, 2006; Kim & Lundberg, 2016; Kim & Sax, 2017, 2009). Fredericks (2011) characterized three categories of engagement: (a) behavioral, (b) emotional, and (c) cognitive. He explained that behavioral engagement is related to attendance, course participation, positive conduct, and participation in school related activities. Emotional engagement focuses on the positive and negative reactions to the school, teacher, and activities. This type of engagement could influence students' sense of belonging. Cognitive engagement focuses on students' investment in learning. For example, students would exhibit cognitive engagement by being thoughtful and purposeful in their assignments so they can comprehend complex ideas in the course. When the Subject spoke of students being engaged, she used it as a positive characterization to describe that a student was exhibiting behavioral, emotional, or cognitive engagement.

Once I recognized that the Subject valued engagement, I considered the one document that outlines for students exactly what their teacher values and expects from them: the syllabus. The Subject has used the syllabus to explain course expectations and policies every semester she has taught at UWG. This inward look into her outward re-presentation provides a historical record of her shifting expectations and values over time.

The Syllabus

I had records of syllabi that dated back to 2015 stored on UWG's online management learning system. I located syllabi from the semesters where the Subject taught precalculus and pulled 6 of them to examine, 3 from fall semesters (2015, 2019, 2020) and 3 from spring semesters (2016, 2018, 2022). I decided to conduct a document analysis (Ezzy, 2002) and start with identifying areas in the syllabi that changed and areas that remained the same. I then examined each syllabus individually. I documented moments in the syllabi where I was uncomfortable reading what the Subject had written. I thought about how she had changed, what she could have done differently, and why this tension occurred. The interpretations and theories I made during these reflections are discussed below where I describe each syllabus individually. I conclude with the Spring 2022 Precalculus course, when the Subject was practicing a critically transitive pedagogy and I was collecting data on her for this study.

Fall 2015 Syllabus

I admired the organization of this syllabus, the underlined words, bolded sentences, and numbered lists. Stars indicated a course policy, and ALL CAPS meant the Subject was serious. I assume that she thought a coded syllabus would be clearer and easier to read. The Subject spent the first day in her courses covering the syllabus, and with one like this length, her voice would be hoarse at the end of the day because of all the talking she was doing. It was a wordy document. As I examined it, I found it full of unequal power relations and modernist assumptions that the student learner is universal and normal (Valero, 2004). These assumptions conceptualized the mathematics learner as self–removed from their own experiences, and therefore their own mathematical experiences were devalued. The Subject placed standards upon students prior to even meeting them, and she measured them based upon their ability to replicate predetermined information. There were rarely exceptions for students, yet she sought to treat students equally, and the easiest way to do that was adherence to policy. She was strict and harsh with grading policies, as evidenced in the syllabus:

> ***All exams must be taken on the scheduled exam day. No late submissions will be allowed.**
>
> ***You will not be able to submit a quiz late. Failure to submit a quiz will result in a 0%, regardless of your reason for missing the deadline. On rare occasions,** [the online homework system] **will have issues and the entire site will go down. If this happens the night the quiz is due, the quiz will be extended.**
>
> ***In addition, if you forget your login information, are having computer issues, or having connectivity issues, the quiz will NOT be extended. If you are having trouble accessing** [the online homework system] **on your computer, try a different computer.**

The Subject would often try to give detail to policies in the syllabus to prevent issues down the line, but her perspective was one-sided and came across as demanding:

> **You MUST contact the instructor 3 days before the exam date…**
> You must complete all homework assignments…

> You must attend 50 minutes of a 1-hour session…
> You must attend 1 hour of tutoring in the CAS…
> …YOU MUST MAKE A 70% OR HIGHER ON **ALL HOMWORK** TO RETAKE AN EXAM…

The all caps stuck out and it immediately brought up a memory. Fall 2015 was during a time the Subject was still teaching large lecture classes, so it was common to use an online homework system to cut down on grading time. The system was set so a student would receive a grade on individual assignments, and then an overall grade for all assignments. A student came in to retake an exam because they made an overall grade of 70% on their homework, but the Subject's expectation was that students were to make a 70% on *each* individual homework assignment to retake a test. I do not remember if she made that clear in class, but it was not indicated in the syllabus, and she did not let the student take the test. Why was she so harsh and strict with the student? The memory makes me tense and uncomfortable, I do not like the way the Subject treated the student, but I embrace the tension. That tension is because I recognize how unbalanced the power relations are in this interaction and how unfair it was that the Subject's misunderstood expectations were prioritized above the student. Unbalanced power relations and misaligned priorities are scattered all throughout the syllabus document. The Subject makes demands of students without offering much in return and she uses language that does not illustrate an equal responsibility to the classroom roles. There is an implicit separation she has created. The entire document is directed *toward* the student, not *with* the student:

> You must…
> You must…
> You must…
> You must…
> You must…
> It is your responsibility to…
> It is your responsibility to…
> You will be required to…
> You will not…

You may be asked to leave…

To examine the Subject's philosophical thinking during this time, I run it parallel to my historical mapping of pedagogical thinking (see Chapter 1). This mapping shows that during the fall of 2015, the Subject was collecting data for SI and intervention tutoring. She was meeting with "high-risk" students and placing them into tutoring sessions. She had assumed the student learner could perform if they could find the "right" tutoring resource. This assumption is evidenced in her 2015 report on Intervention Tutoring (see Appendix J):

> My end goal is for Math1111 instructors to have the ability to categorize students into a risk category based on a variety of easily obtainable factors and promote the appropriate resource for each risk category. Giving a student this type of information within the first week of class will help them manage their time and understand what is expected for them to succeed. This may also encourage instructors to start incorporating these resources within their class, so students have a much better chance of passing the class with a strong understanding of the topics covered. (Spring 2015)

Spring 2016 Syllabus

The spring 2016 syllabus was identical to the Fall 2015 syllabus, aside from a change in dates. This course was designed to be re–used. There was no consideration that students would be different, providing further evidence that the Subject perceived students as universal (Valero, 2004). She was trying to meet with more of them in her office and she used this time to promote the tutoring sessions. This effort is evidenced in her 2016 report on Intervention Tutoring (see Appendix K):

> Students were asked to meet with me at different times based on their need. If a student was High Risk and Indicated they wanted a tutor, they were asked first to meet with me and sign up for Intervention Tutoring. The next group I asked to meet with me were High Risk students that indicated they did not want a tutor. Next were Moderate/Low Risk students that indicated they wanted a tutor. For the Low Risk students that indicated they did not want a tutor, I sent an email letting them know I did not see a need to meet, but to please notify me if they begin to struggle in the class. All students that met with me were asked if they would like to sign up for Intervention Tutoring. (June, 2016)

Spring 2018 Syllabus

The Spring 2018 syllabus had some changes. The Subject required that all students had to meet with her twice during the semester and made the meeting a graded item in the course. Spring 2018 was when she noticed that several students who signed up for the tutoring sessions during their student-teacher meeting were doing well in class if they were attending the sessions. She also enjoyed getting to know the students a bit more during the meeting. The Subject perceived this knowing as a benefit, so she "forced" students to interact with her so she could promote the sessions; evidenced in her 2018 report on Intervention Tutoring (see Appendix L). Other colleagues were implementing the tutoring program during this semester. When describing the meetings, she wrote:

> For Spring 2018, Mrs. Carmack made the student-teacher meetings mandatory for students. Students [were] to meet with Mrs. Carmack twice during the semester, once at the beginning of the semester, and one more time toward the end. These meetings contribute to 3% of the students' final grade. As a result, of the 66 currently enrolled students, only 3 did not schedule a student-teacher meeting. During their first meeting (which occurred within the first 4 weeks of classes), the Intervention Program was discussed, and students were given the opportunity to sign up. (August, 2018)

The language in the syllabus does not feel like the Subject authentically wants to use the meetings to get to know the students so they could build a relationship. I tried to recall the Subject's intentions, but I do not remember them. I re-write her. I use my knowledge of the Subject's past experiences to conceptualize a past self. I assumed that her intentions were that she wanted students to feel comfortable coming to her office, she wanted them to do well in the course, and she wanted to encourage the tutoring program not only because she believed it to be beneficial, but also because it was benefiting her career. She was receiving grants and presenting at conferences. Yet, her methods to promote the program were saturated with unequal power relations (Foucault, 1982). As faculty, she was already situated in a position of power, and forcing students to have a social interaction with her strengthened it.

It was after this semester during summer of 2018 that the Subject attended a teaching and learning institute in Virginia where the goal for the week was to develop a learner-centered[26] syllabus. At the start of the week, she chose the college algebra syllabus as her undertaking and began the difficult journey of designing a document that was already designed to be unchangeable. Recent goals in the department had been to create a singular, unified syllabus, which had been accomplished. She was not permitted to change the course description, course materials, or learning outcomes, although she could add to it. She could also modify how the student would be assessed and the course schedule. While reflecting on this memory, I returned to the first learner-centered syllabus the Subject created. I had kept it stored away, anticipating I would return to it later. I recall it took the Subject a while to figure out a way to change the syllabus. She spent an afternoon at the institute working on it. She sat for an hour with no ideas, trying to figure out what to do. Then she thought about what she could change so she could appear more approachable in the syllabus. Appearing more approachable was one suggestion for a learner-centered syllabus, but the Subject had spent much of the time on policy development in the syllabus up to this point and had not really considered how the language could influence students' perceptions of her, thus influencing their decision to engage with her. To appear more approachable, she started with jokes, for example:

> Where are mathematicians buried?[27]
> What do organic mathematicians throw into their fireplaces?[28]

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[26] A learner-centered syllabus highlights the experiences that students will have in the course and redesigns the document, so faculty appear more friendly and approachable (Richmond, 2022).

[27] The symmetry.

[28] Natural Logs.

The Subject was trying to guide the way the student learner perceived her, but she still perceived the student learner as universal and normal, separate from their own mathematical self. Engaging in this institute did not broaden her understanding of the student learner but reinforced the idea that she could control something about them. In this case, she could manipulate language to control how a student perceived her.

Fall 2019 Syllabus

It is evidenced in the Fall 2019 syllabus that there were changes made to the document after the Subject attended the Virginia institute, but not much. She worked on the college algebra syllabus at the institute, and this was the precalculus syllabus. They are similar, but the traditional syllabus was already developed for precalculus, and she had a busy summer, so she made few changes to it. She added more transparent information, like a course content list, and taking a lesson from the institute, her language also appeared less demanding:

> You will be…
> Students will be given…
> If a student misses…
> You can acquire…

The syllabus was still full of strict policy and representations of unequal power relations. There are expectations directed toward the students, and no assurance that the Subject is offering anything in return. The students were still required to meet with her, although it dropped to meeting only once instead of twice during the semester.

During that fall 2019 semester, I took a Research Methodology course at GSU, taught by Dr. Janice Fournillier. During that course, I identified student–faculty interaction as my dissertation research topic. In the classroom, the Subject was meeting with students and having more conversations with them, which fostered my interest in interacting with them. I conducted a pilot study during the course to gain valuable experience collecting data. I had decided to study faculty perception of student–faculty interaction and used my colleagues as participants. I used interviews and photo elicitation as data to explore their perceptions of student–faculty interaction. During the methodology course, we studied various qualitative research methods through course assignments, one being a document analysis. Given my experience redesigning a syllabus with the Virginia institute, I chose to examine the UWG undergraduate mathematics syllabus. In the course assignment, I described my analysis:

> I began my analysis with an investigation into the common language of a syllabus and policies regarding syllabus standardization. I wanted to follow the advice of Prior (2002) and understand how the document is produced and how the document is manipulated in situ. I first spoke with the director of Freshman Mathematics regarding the social trajectory of the syllabi. It was indicated that undergraduate mathematics courses require standard language on the syllabi, and this was a decision made several years ago by the department chair at the time. Currently, change requests to the syllabi are passed to the chair of the Freshman Math Committee, where it is voted on by the committee members. As explained, teachers can add to the syllabus, but they cannot remove the common language. I explored this further by analyzing the template of the standardized syllabus with my participant's syllabus. Upon doing so, I questioned why and how the decision was made to standardize portions of the syllabus, which made those portions static and difficult to change. (Spring, 2019)

The rigid structure, strict policies, and outdated learning objectives of the mathematics syllabi went against what I had learned at the Virginia institute, although I embraced those elements in semesters prior. In my report for Dr. Fournillier, I advocated for a change:

> Literature has suggested that finding ways to show approachability improves student teacher interaction. Harnish and Bridges (2011) found that faculty providing friendly syllabi were perceived as more approachable, where the attributes of friendly syllabi included friendly language, moderate self-disclosure, rationale for assignments, humor, compassion, and enthusiasm. In Richmond and colleagues (2019) study on learner-centered syllabi as it relates to student perception of student–faculty rapport, they found that "participants perceived the hypothetical professor writing the learner-centered syllabus as more creative, caring, happy, and enthusiastic" (p. 165). (Spring, 2019)

I noticed that what the participants in Richmond and colleagues (2019) study valued had nothing to do with the syllabus itself but most everything was due to perceived faculty behavior.

How would the faculty *be*? Students wanted faculty who supported them, encouraged them, and were “nice” to them. These results are similar to the findings that Anderson and Carta-Falso (2002) reported, where both students and faculty desired a supportive climate. These studies provided evidence to suggest that the syllabus may be a first impression for students, but it is faculty behavior that they are most concerned with.

Fall 2020 Syllabus

The Subject was teaching face to face for the fall 2020 semester. Instruction moved to a hybrid model due to COVID-19 and she used a flipped-classroom design to conduct her course. For her flipped-classroom design, she wrote out detailed notes and made online videos for students, and they were to come to class to ask questions. Most students opted to stay home and ask questions via email. UWG started to use the online syllabus management system during COVID-19. Administrators wanted common components in the course syllabus for student accessibility, but these components were nothing that further restricted what the Subject could do in the classroom. They did make developing a learner-centered syllabus more difficult, so she focused on the areas of the syllabus that she could modify. The course description could not change, nor could the student outcomes. She used open-source materials and changed some of the grading criteria. She still required a student–teacher meeting, virtual this semester and only one. She included homework that students would upload for feedback, and this was the first course that she asked students to complete an assignment for their final grade that was not an exam. This semester appears to be the first transformation in the Subject’s pedagogy as her perception of the student learner begins to change. The Subject provides evidence in her 2020 Annual Faculty Report that she had started to perceive the student learner as a context-dependent, cultural self. She placed less value on exams and encouraged students to nurture their own interests and connections to mathematics:

> But the most significant pedagogical change I have made (in what I believe is my entire teaching career) occurred during this semester. While we were forced to make substantial changes to our pedagogical practices to meet the needs of students and overcome challenges caused by the COVID-19 pandemic, and along with the University reorganization and my move to the newly formed Department of General Education, this moment presented itself as an opportunity for me to try something new in an undergraduate mathematics course. I felt I had more autonomy within my new department, and while I was developing my courses for the Fall semester and deciding on my pedagogical approaches, I made the choice to employ an ethnomathematical perspective (Mukhopadhyay et al., 2009) into the curriculum of my PreCalculus course. This ethnomathematical perspective is one that considers students' experiences with mathematics and what they are interested in learning about. I still taught the classical mathematical content, but I eliminated all exams (whose aim was replication) and replaced them with a reading and writing project. (Spring, 2021)

She then described the reading and writing project in her report:

> I created a project where students had to select a mathematical topic to research, and then do so. They were required to select sources to read and write about, and also required in the writing assignments were reflections where students were able to think openly about the mathematics they were learning about. They had the opportunity to ponder the questions "What is mathematical *knowledge*?" and "What is mathematical *knowing*?" As the writing assignments were submitted, as I read through them, I was overjoyed. Students were thinking about mathematics *differently*. They were acknowledging mathematics as a part of everyday life, as a part of their culture. (Spring 2021)

I reflected on this moment and ran it parallel to the historical timeline of my rethinking pedagogy (see Chapter 1). This semester was after the Subject had spent a couple of years engaged in literature that explored philosophical perspectives and examined socio-political and cultural aspects of mathematics education. The Subject needed this space so she could conceptualize something *different*. She mentioned it in a reflection she wrote during summer 2020 when she was enrolled in a Postmodern Theory course with Dr. Stinson, online. She wrote:

> I will say, this is some deep thinking that I never have experienced before. I feel that at this point in my studies, I can wrestle with these ideas and make sense of the philosophical thought that I need to employ. It is so empowering to feel my own progress. (June 17, 2020)

It was evidenced that during the Postmodern Theory course during summer 2020 that the Subject began to conceptualize the student learner differently. Early in the semester, she questioned current teaching practices, including her own, as evidenced in her reflection:

> This reading was helpful for me to learn more about the message of postmodernism and I found myself reflecting most when the authors located education in the postmodern (p. 24). It frustrates me to see undergraduate mathematics education as a space that confines and limits many students, rather than a space that empowers them and celebrates their differences. Also, I find myself growing more impatient with math folk when they focus so much on student readiness/ability (this it quite a bold assumption to believe one knows what the other does or does not know), student cheating (I don't think there would be much cheating happening if students viewed their math courses as useful, empowering, or even necessary), or are adamant that students know how to regurgitate procedural information that has been fragmented and removed from context. Yet it makes complete sense when you realize that education was created with a modernist agenda. It does not empower or celebrate students but shapes their identity so they behave and become the type of student that the dominant culture finds useful, and therefore, worthy of the flawed education presented to them.
>
> So I reflect and ask myself: what power do I have in the academic space? How can I change an academic system with deep roots that clasp to the belief that knowledge is and can be objective and absolute? How can I persuade others to think about education, knowledge, truth 'differently'? (June 11, 2020).

The Subject questioned what she could do differently in the academic space so more students could benefit from the courses she taught, but she felt limited in what she could do. She was a non-tenured faculty member in a math department where many senior members were reluctant to change. Some of them regarded the courses she taught as unnecessary for math majors, so there was little interest in course development, and all of them held traditional perspectives that the Subject was now questioning. Change seemed impossible. But then, the Subject read works of Michel Foucault (1976/1990, 1982). Foucault provided the theoretical tools for the Subject to understand how power operates. Foucault explained that discourse can shape and manipulate people by subjecting them through practices that categorize and label them. The Subject began to think about what she did in her practice to maintain unequal power relations and exercise power over the student:

> How do I contribute to these relationships in my teaching? Teachers subject students to many narratives, one being the “good” mathematics student, one who can be categorized, whose identity can be guided. A “good” student takes this course in the first year. A “good” student completes the expected tasks in the course. A “good” student will be a “successful” student. It has been a struggle for me lately because I am an active part of the system! What I really want to tell the students is that it is all made up! To do so, however, would have negative consequences for me (or at least I think they will). How hypocritical of me to belong and contribute to a system I so much want to fight. It has been a difficult realization that I knowingly contribute and justify my selfish reasons for doing so. (June 23, 2020)

The readings provided space for the Subject to think about systems of power and how they act to differentiate. She considered how she labeled and categorized her students, how she subjected them through her own judgements and interactions, and how that could have influenced them. She thought about how these categorizations created boundaries and limits. She thought about Lyotard’s (1984) suggestion to accept limits, but to recognize they are never established once and for all. They are not fixed or absolute. The Subject began to perceive the student learner as a fluid, constructed, and subjected self. After the Summer 2020 Postmodern Theory course, the Subject received the news that UWG was going through a complete reorganization, and she would be placed in a newly formed department in a newly formed college. The Subject was given an opportunity to push the limits of traditional mathematics teaching, so she took it. She was no longer under the control of a math department that refused to adapt to change, so she decided to make her first radical pedagogical transformation. She eliminated all the exams in precalculus and replaced them with a project that gave students space to nurture their own relationship to mathematics.

The Subject was nervous about the change in her Fall 2020 Precalculus Class, but as the student writing came in, her nerves turned to excitement. The connections that students were making were rewarding for the Subject to see, and she deemed the project a success. It was, however, not a traditional semester. This was during the height of the COVID-19 pandemic, but the Subject planned to conduct a future course in a similar manner to see if she would get the same results.

Over the holiday break, the Subject experienced a massive panic attack after visiting her neighbors for lunch on Christmas. Her neighbor was a therapist and convinced the Subject to meet with a colleague of hers for the panic attacks. The Subject was not hopeful. She had dealt with anxiety her whole life and had just assumed that the panic attacks were a direct result of that. She met with a therapist for a few months and then in May 2021, she had another massive panic attack on her way to North Carolina. The Subject met with her therapist soon after, and she did an EMDR session with her immediately. The Subject's multiple selves converged with each other, and this session transformed her interactions with students. They were easier. It seemed like she cared more about her students just because they were human. The trauma that her body held onto influenced the way she interacted with others, and she was closed off from the world. She was released from it that day.

The Subject was scheduled to teach precalculus that summer. She had started to feel an obligation to balance the power relations between her and her students, so she entered the classroom on the first day of classes with a partially developed syllabus. She and the students collaborated on the course building, taking into consideration how the students wanted to be assessed and how they wanted the assessments to happen. The relationships that the Subject built with the students were different that semester. They seemed more trusting. The students talked to her about issues in their personal lives and the Subject felt she was better able to support the students through learning about them in the reading and writing project.

The opportunity to diverge and construct a classroom environment that is not typical of a traditional mathematics classroom would not have been presented if the Subject had not received support from her colleagues. Her placement into the newly formed Department of General Education positioned her with colleagues who were also seeking change, and her chair and dean encouraged her to try creative approaches to teaching mathematics. A colleague in the newly formed department was also interested in making changes to her classroom. She taught first year English courses and both her and the Subject were interested in interdisciplinary concepts. They decided to create a collaborative course of Precalculus and English Composition that connected thematically by culture. They wanted to have the same students in both courses, so they asked their department chair and college dean if it were possible. They were excited about the Subject and her colleague's ideas and were able to make it happen. The Subject's Precalculus course was set at MWF at 9:30am in the morning, while her colleague's course was held on MW at 11:00am. They both had openings in their schedule so they could visit each other's classes, and through system overrides and a supportive advisory staff, they were able to enroll thirteen students into both courses.

Spring 2022 Syllabus

The precalculus course that the Subject selected to thematically link with English composition was the Spring 2022 Precalculus course that she used for data collection. For this course, the Subject presented culture with three perspectives: culture-of-others, culture-of-self, and expression-of-self. She and the students started with culture-of-others by exploring how different cultures use mathematics and how it can connect to their own. These multiple perspectives help students to conceptualize mathematics as a culturally derived system, where social conditions shape their mathematical self and thus shape their mathematical knowledge and learning (Greer et al., 2009). The students explored culture-of-self by turning the lens inward and writing about their own experiences, beliefs, and values of mathematics education. Students began to realize they have been limited by the discourses available to them and have been influenced by many factors in their lives, all shaping their mathematical self (Kincheloe et al., 2011; St. Pierre, 2000; Usher & Edwards, 1994). With this perception, students may stop internalizing their abilities to work through problem sets and better acknowledge the value of their own thoughts and ideas. Toward the end of the semester, the course shifted to expression-of-self. This shift provided an opportunity for the Subject to support the students' unique mathematical self. Students were requested to present their work from over the semester and highlight the mathematics they connected with.

By studying student–faculty interactions during the spring 2022 semester, the Subject was able to place a lens on her interactions with students and act on those moments when she felt unbalanced power relations with students. By being aware of and acting to balance these power relations, her interactions with them were supportive and caring. There are several moments in the semester where she felt that she connected more with a student than she would have in the past. Throughout her journal entries, she describes some of these moments:

> She came and asked a question to me directly. She wanted to talk about those experiences that caused her anxiety, one being from last semester. (January 25)
>
> We chatted about it for a bit, and she said she enjoyed it. She showed me the book they are reading. She also shared how she went home and asked her Dad about the math problem we did this week. (February 11)
>
> He also talked with me after class today. He talked about his last teacher. He mentioned that he felt degraded by him and talked about that experience. (February 11)
>
> She was excited to show me her presentation this week that she worked on in another class. It looked really good, and I was happy that she wanted to share it with me. (February 11)

> She came into my office this week. She just looked down. I asked if she was ok, and she hesitated. I think she was just going through a hard time and had a bit of a lack of motivation. We chatted for a while, and she seemed to be in good spirits when she left. (March 11)
>
> We talked about mental health. We talked about the counseling center. (March 31)
>
> She read the poem, her voice cracking. I couldn't hear all of it, but she was focused. I told her it was awesome and Colleague1 came over. I said to read the poem again, but let's go in the hall. Then, it was clarified. That poem was for her cousin, who died in a motorcycle crash the previous Friday, and this was the poem she was reading at his funeral. Oh. Colleague1, me, and Student1 go down to my office…. She stayed in the office for a while. (March 31)
>
> Not in judgement, but I think she was so afraid of that judgement, she broke down. (April 8)
>
> We had lots of hugs, every one of them gave me a hug. (April 29)

The students were vulnerable in these moments, but the Subject provided the type of support in class for them to feel comfortable and heard. She prioritized their well-being and was willing to communicate, reflect and adapt to their needs. In turn, the students showed a reciprocal supportive relationship to her by showing up and engaging with the course content.

In her critically transitive pedagogy, the Subject shifted from traditional conceptualizations of the student learner, evidence by her previous syllabi. This shift influenced her interactions with students, while her divergence of traditional mathematics teaching provided more equitable opportunities for them to engage with mathematics. These shifts and diverges resulted in several positive student outcomes. These student outcomes will be discussed in Chapter 6.

Concluding Thoughts

In this study, I sought to explore student–faculty interactions within the context of the Subject's critically transitive pedagogy. Through my analysis, I was able to capture transformations in the Subject's pedagogy over time. These transformations occurred after she had been provided with the opportunity to broaden her understanding of teaching and learning mathematics, revealing that her perceptions of the student learner were confined by the discourse available to her (Kincheloe et al., 2011; St. Pierre, 2000; Usher & Edwards, 1994). For Foucault (1976/1990, 1982), discourse creates subjects and objects, and the mechanisms for positioning subjects within complex power relations. Perception constitutes discourse, so it serves as a form of power. I found that the Subject's pedagogical positioning provided the blueprints for her perception of the student learner, influencing the power relations between her and them (St. Pierre, 2000). These power relations operated when the Subject confined (or supported) a student's mathematical self.

CHAPTER 6

SUMMARY AND DISCUSSION

Student–faculty interactions are contextual and contingent. They are influenced by experiences, relationships, values, and beliefs while constituted with and in sociopolitical discourses. They are unique experiences located in an ever-changing context. There is plentiful evidence to suggest that students' interaction with faculty is central in shaping their engagement, which enhances their learning outcomes and influences their decision to remain enrolled (Cole & Griffin, 2013; Kim & Lundberg, 2016; Kim & Sax, 2017, 2009), but most studies on student–faculty interaction do not examine the conditional effects of students and faculty. They regard the student and faculty as removed from their context and stripped of their individual characteristics. The conditional effects on student–faculty interaction remains theoretically and empirically underdeveloped, but some research in the past couple of decades have considered conditional effects by examining them across gender, race, first-generation status, age, and social class (Cole & Griffin, 2013; Kim & Sax, 2017). Once these conditional effects were taken into consideration, the evidence suggested that student–faculty interactions were not so beneficial for everybody, and they were the most significant way that minoritized students were hindered (Kim & Lundberg, 2016; Park et. al., 2020b).

The aim of this study was to examine student–faculty interactions as contextual and contingent experiences. I used an analytic autoethnography (see Anderson, 2006) to examine student–faculty interactions by exploring the context surrounding the Subject's (i.e., self) pedagogical transformations. The transformations represented a divergence in the Subject's web, a moment where she shifted her perceptions and beliefs. I explored those moments to understand why the pedagogical transformations occurred, finding that the Subject's multiple selves influenced and constituted each context (Ernest, 2004).

The Subject's pedagogical transformations were a result of her shifting values and perceptions of the student learner, which shaped her interactions with them. Her course syllabi provided the evidence of these transformations and located the moments when I examined her context and the influences that surrounded it. The exploration into the Subject's context provided an opportunity to interrogate her past beliefs and locate her pedagogical positioning. I used my research question *How does the Subject describe interacting with students within the context of a critically transitive pedagogy?* to guide my analysis, but the purpose of this study was not to provide an answer to this research question per se. The Subject had experienced a change in the ways she interacted with students after she made radical changes to her pedagogy, so the purpose of this study was to explore why those interactions changed and the sources of their influence. I was able to capture the transformative process that the Subject experienced and reveal how traditional mathematics perspectives can be damaging for students. Using analytic autoethnography as my research methodology, I was committed to its spiraling theoretical development, refinement, and extension (Anderson, 2006). I used Foucault's construct of power relations to examine the Subject's context at her moments of transformation and found that these power relations were constructed, in part, by her own perceptions, experiences, and beliefs. Power relations are a form of power that can act to differentiate and categorize an individual. It limits and confines the person to the characterization placed upon her. Once she is aware of the limits placed upon her, she can dismantle them and transform her space. Her ability to transform was confined by the discourse available to her, but also influenced by her willingness to broaden her own perspectives, values, and beliefs.

This research is grounded within a critical postmodern framework (see Stinson, 2009; Stinson & Bullock, 2012, 2015). Critical (e.g., Kincheloe & McLaren, 2011) and postmodern (e.g., St. Pierre, 2000) theories provided the necessary tools to explore how student–faculty interactions are contextual, contingent, and politically situated, maintained, and reproduced through systems of power and power relations. Critical researchers use their scholarship to reveal and dismantle the power that produces and reproduces inequality in institutions, such as schools (Stinson & Bullock, 2012). A central feature of this theory is to engage in social critique and promote institutional change to improve aspects of social life (Ernest, 1997). Using a critical framework for this study provided conceptual tools to reveal how traditional mathematics ideology is too often harming undergraduate students. Traditional perspectives often confine and control the development of a student's unique mathematical self. I aim to use this research to promote social change and a *different* way of teaching undergraduate mathematics (Ernest, 1997, Kincheloe et al, 2011).

Postmodern theories provided the theoretical tools to examine the Subject as a constructed, multiple, changing, confined self-in-context (Ernest, 2004; Walshaw, 2011). The Subject is positioned within a web of merging, diverging, and intersecting moments that influenced who she was, who she became, and who she is becoming. She is positioned by flexible power relations (see Foucault, 1982) that alter her context and shape her perceived self (Ernest, 2004; Kincheloe et al., 2011; St. Pierre, 2000; Stinson, 2009, 2012; Usher & Edwards, 1994; Walshaw, 2001, 2011). Applying postmodern theory to the Subject's positioning provided the tools to examine her as confined and constituted; where her multiple selves are made and re-made by her experiences, beliefs, and values. By examining the Subject in this way, I could explore the power relations operating within each context to reveal the influences in her transformations.

The Study

The Subject in this study is the self. She has taught undergraduate mathematics for over a decade at University of West Georgia (UWG), and she taught mathematics in a traditional manner for many years. She would use a grade structure where final student grades were mostly determined by test and quiz scores. Homework was usually part of the grading structure, and she often used an online homework system that was purely procedure driven. When the Subject enrolled at Georgia State University (GSU) in 2017 to begin the doctoral program, she had not considered mathematics to be outside of the isolated domain of problem sets and procedures. But broadening her perspective of mathematics was, and was not, a difficult process. All it took was engagement in literature, reflecting on what she read, and having discussions with her peers. The multiple perspectives just had to be introduced to her so she could consider them, but she had no experience with mathematics being anything other than problem sets, so it took time. It took a year of reading and writing to begin making sense of the abundance of theories and perspectives of mathematics and mathematics teaching and learning. The Subject continued on with her coursework at GSU and took a Sociology in Education course. In this course, she connected mathematics education to social inequality, and she became angry at how institutions (i.e., public schools and universities) in the U.S. operate under an ideology (i.e., White Supremacy) that reproduces inequality by granting value to some students and de-valuing others (deMarrais & LeCompte, 1999; Fleming, 2018; Jensen, 2005; Rooks, 2017; Valenzuela, 1999; Valero, 2018). She was angry at herself for ignorantly participating in the system. Perspectives that led her to question her purpose and practices in the classroom were only emphasized after she took this course, and she was determined to make changes in this system that was now so effortlessly reproducing social inequality.

When the Subject took courses in critical and postmodern theories, she considered how she de-humanized and de-valued students when she labeled them, categorized them, and removed them from their context. She considered the power relations she had with them, how she subjected them through the ways she taught and when she interacted with them. With the understanding that power is a flexible relationship, always present but always capable of resistance (Foucault, 1982), the Subject realized she could build positive relationships with students more if she could better balance these power relations. For example, she used assignments that did not label students and categorize them. She used assignments that gave them the opportunity to reflect on their social positioning and how it influenced their mathematical selves, and she collaborated with them to build the course. She began to operate with a perspective that students are context-dependent mathematical selves with multiple motives for learning, who have been confined and subjected (Ernest, 2004; Kincheloe et al., 2011; St. Pierre, 2000; Stinson, 2009, 2012; Usher & Edwards, 1994; Walshaw, 2001, 2011).

After she had considered multiple philosophies and theories of mathematics and mathematics teaching and learning, had taken the courses that made her angry and question her own teaching practices, and once her perspective of the student learner changed, the radical transformations occurred, but only because she could bring her intentions into the social space she occupied (Valero, 2004). She was given support to make changes in the classroom and experiment with pedagogy. Once the pedagogical changes occurred, then her interactions with students changed, and that change was not subtle. It was so significant that it convinced me to conduct this dissertation study on it. I wanted to understand what parts of that context were so powerful that they changed a social interaction that much.

Results and Student Outcomes

I used analytic autoethnography (see Anderson, 2006) to study the context of self and represent her as the Subject of my analysis. I use the Subject's memory, her journal, her past course syllabi, teaching documents, professional documents, student writing, and transcribed colleague and student interview data to explore the context of the Subject's transformations. I applied Foucault's (1982) concept of power relations to the analysis by interrogating the Subject's memories and her multiple selves to illuminate the influences in her transformations. By applying this theory, I recognized that the Subject's perception contained power relations that operated when she confined a student's mathematical self through traditional perspectives and practices. It is important to highlight how these traditional perspectives and practices are harming students, so I present a depiction of the Subject's described experiences transforming her pedagogy to reduce this harm.

The Subject's Experience

The Subject's transformed pedagogy has been characterized as a critically transitive pedagogy with two major goals, to prioritize ethics and value each student. When ethics are prioritized in the mathematics classroom, a student's wellbeing and development are important components. Maintaining high academic standards and challenging students to push the limits of their unique mathematical selves contributes to their development. Engaging in literature is vital to be aware of and involved in conversations that are relevant for student development and wellbeing. Mathematics education and mathematics education research have a fluid nature, and if I do not engage with current and relevant literature, I run the risk of not providing a quality education for my students. I would be stuck in a moment with unchanging perspectives and practices, potentially losing relevancy for students. This loss is especially true during times with rapid change. The most recent and significant social changes have been the results of technological progress. In the past 40 years, society has completely transformed how information is stored, accessed, and used, but traditional mathematics education has not shifted its purpose or practices. Students must still prove their "ability"[29] to replicate procedure, yet this procedure is easily accessible (e.g., smart phones). I do not claim that the procedures are not important, but there should be other elements in a mathematics classroom that considers these technological advances. For example, because of the easily accessible information, students now have opportunities to learn how to analyze this information with a mathematical lens, or they can learn how to identify when mathematical information has been manipulated. It is a disservice to students if they are completing mathematics courses and only learning procedures and formulas so they can prove their ability to replicate those procedures. Procedure is not the only relevant consideration for a mathematics student.

To value each student is to foster the development of their unique mathematical self and provide equitable opportunities for each of them to engage in mathematics. The Subject did not acknowledge each student as a unique mathematical self until she transformed her perception of the student learner. When the Subject perceived the students as universal and removed from context, she imposed teaching methods that labeled and judged them. She constrained their relationship to mathematics by telling them what to learn, how to learn it, and how to represent it. The students had to stifle their own relationship with mathematics and had no opportunities to explore it. When the Subject transformed her perception of the student learner and began to teach

[29] The concept of a student's mathematics "ability" is troubled throughout this discussion by asking questions such as: What is ability? How is ability demonstrated? Who evaluates ability? What evaluates ability?

with a critically transitive pedagogy, she began to operate and support the students in ways that would foster their unique relationship to mathematics.

Reading and writing assignments contributed to the Subject's transformations. Witnessing students' thoughts and connections to mathematics while learning about their unique mathematical selves, how it had been confined and subjected, further humanized them, and provided the space for the Subject to foster the students' unique relationship with mathematics. In turn, students engaged with mathematical concepts more often and took risks in the classroom because they knew they would not be judged or labeled because of it. When the Subject taught with a critically transitive pedagogy, the students' development and wellbeing were prioritized, and when students received that type of support, they reciprocated by showing kindness and respect back. They showed support for the Subject by coming to class and participating in course activities. Students approached the Subject more often and had more conversations with her that necessitated a level of trust that she felt they had. This type of relationship affected students, and there were significant student outcomes that the Subject experienced when she taught mathematics in this nontraditional way.

Student Outcomes – Some Anecdotal Evidence

It has been 2 years since I have collected data on the Subject, and the student outcomes she experienced have continued in courses where she teaches with a critically transitive pedagogy. The Subject still uses the first day of the semester as syllabus day. Excluding online courses, she asks students in her face-to-face courses how they want to be assessed, what types of assignments they would like, and what they want the course policies to be. It is common that students are unsure what to say, but when she mentions that they do not have to take tests (aside from the one mandated test), she hears the same breath of relief escape them. Faces look up, and then they light up. Once the Subject explains that tests are not required (aside from the one mandated test), students are typically open to most assignments she suggests, which may even include another major test. The Subject just has to de-value the test and weigh it less than other assignments. Students having a say in course policies and how their mathematical comprehension is assessed shows that their input is valued and makes them more invested in completing course assignments. The work is more meaningful to them because they have the power to bring their interests and intentions into the mathematical space they occupy (Valero, 2004). When the Subject taught her classes this way, she described experiencing increased engagement from students in and out of the classroom.

The grade structure in the Subject's critically transitive pedagogy has always had less emphasis on timed exams and quizzes, and more on assignments that explore broader mathematical concepts and how mathematics is culturally connected (Greer et al., 2009). Students are asked to write about their unique mathematical selves and explore their own social positioning. These types of assignments may be resisted in a traditional mathematics course because of the judgement that they are *not* mathematics. This judgement can often be located within a formalist perception of mathematics that limits it to precise formulas and procedures with numbers and symbols (Renert & Davis, 2010). With this perception, anything outside of a formalist characterization is deemed not mathematics and thus irrelevant to a student learning it. The purpose of students learning mathematics is usually for them to understand the meaning and execution of specific concepts, formulas, and procedures in isolated branches of mathematics. Their learning is evidenced through their ability to accurately replicate the procedures and arrive at a precise conclusion. I would argue that those who operate with this perspective have a confined definition of what mathematics is. Ernest (2009) argued that mathematics consists of more than just abstract knowledge representations; mathematics includes a broad range of human activities and knowledge-based practices.

Ernest (2004) listed the activities that A. J. Bishop identified in his 1988 book *Mathematical Enculturation: A Cultural Perspective on Mathematics Education* as the cultural basis of mathematics. They are to sort, count, locate, play, make, design, plan, explain, argue, and measure. These are all activities that people *do* to use or develop their mathematical proficiency, but a traditional mathematics course operates in a formalist perception of mathematics and most assignments use a student's ability to replicate specific procedures as evidence of student learning. Replication is not an activity that builds on the cultural basis of mathematics. Using it in the classroom as evidence of student learning is not actually providing evidence of a student's ability to *do* mathematics but instead provides evidence of a student's ability to *replicate* mathematics. When the Subject de-valued replication in the mathematics classroom, the type of mathematics she taught did not seem to matter. Many students enjoyed pushing their limits and engaging in challenging mathematics if they experienced personal development and little judgement. Students overall did not have problems *doing* mathematical procedures and applications if they were provided the opportunity to foster their own connections with the topic. Problems occurred when they had to replicate those procedures on a test that would measure, categorize, judge, and confine them to become a controlled version of their unique mathematical self. When the Subject de-valued replication, she was more concerned with what students could do to develop their mathematical selves rather than their ability to replicate specific information. To de-value replication as evidence of student learning, she removed most assignments that used it and added assignments that built on the activities that constitute the cultural basis of mathematics. The narrative biographies and annotated bibliographies were some of the assignments that she added to accomplish this goal in the Spring 2022 Precalculus and English Composition collaborative course. These specific assignments were also used in the English Composition course, where the Subject's colleague taught narrative writing and used the annotated bibliographies to teach other topics in her course.

The narrative biographies were designed so students could acknowledge and explore the limits of their mathematical self. The assignments encouraged students to reflect on the influences in their own lives and connect these influences to their beliefs and perspectives of mathematics. It is correct to argue that these writing assignments have no numbers, formulas, or procedures, but they do provide an opportunity for students to transform an unhealthy perception of their mathematical self into a better one. The students can push their constructed boundaries when they begin to realize that their mathematical ability was more about their mathematical positioning than it was their ability to actually do mathematics. The annotated bibliographies were a second writing assignment in the course. These assignments were designed so students could have the opportunity to study and do mathematics by locating, making, designing, arguing, explaining, or measuring mathematics inherent in a topic in which they were interested in studying. The students made their own mathematical connections and contributions, therefore providing space for the Subject to value their work and celebrate the students' unique mathematical selves, a major aim for a critically transitive pedagogy. The writing assignments contributed to positive student outcomes that the Subject experienced. When students engaged in the project, their work represented mathematical and social connections that went beyond anything she would see in replicated mathematical procedures.

Having space to celebrate students and their work motivated them to engage in the mathematical learning process. Some of this engagement occurred in class. The Subject noticed in the spring 2022 semester a change in student attendance. In traditional mathematics courses, she typically experienced a drop in student attendance as the semester continued. Colleagues across campus have described experiencing the same drop in their courses, and they described the spring 2022 semester attendance to be especially low (i.e., the lingering effects of COVID). When the Precalculus course began, the Subject questioned if attendance would be a problem. On syllabus day, the students indicated that they did not want an attendance policy, but they also wanted a lot of in-class assignments. What happened was that student attendance was better than it had ever been for the Subject. Of all students enrolled in the course, 93.8% of them completed the Precalculus course with passing grades, and 75% of them completed the course with a grade "A." When the Subject provided opportunities for students to contribute to course development and she had space to support their unique mathematical selves, low attendance was not an issue. When courses are restructured to provide more opportunities for students to do mathematics, then more students can engage with it.

When students are given support in their mathematical development, are given opportunities to do mathematics and learn without judgment, and feel valued for their contributions, they are more likely to engage out of the classroom. For the past 3 years, UWG's Department of General Education has held an annual on-campus conference for students who are enrolled in undergraduate courses at UWG: At the Core. This conference is designed to celebrate student work and provide them with an opportunity to participate in public speaking and professional activities. Eleven of the thirteen students enrolled in the Spring 2022 Precalculus and English Composition collaboration course presented their work as a poster presentation at the initial At the Core conference at UWG. For spring 2023 semester, the Subject taught two sections of Precalculus where she assigned a reading and writing project. The students were asked to develop a final presentation and present their work. The students could choose how they presented: (a) take an exam, (b) write a research proposal, (c) give a class presentation, or (d) present a poster for the General Education conference. Of her 42 precalculus students, 26 presented at the General Education conference, equivalent to 61.9%. Another five students gave a class presentation, eight students wrote a research proposal, three students did not complete the final project, and only one student decided to take the final exam.

The student outcomes that the Subject described experiencing when she taught with a critically transitive pedagogy has implications for student retention. More students have engaged with and passed courses where the Subject taught with a critically transitive pedagogy, suggesting an effect on their decision to remain enrolled, but more research is needed to explore that effect. I discuss this and other future research that can arise from this study below, but first, I address the limitations of this study.

Limitations

The purpose of this study was to examine student–faculty interactions as contextual, contingent, always-changing experiences. I highlighted the Subject's pedagogical transformations, and by applying theory to her context, recognized the power relations in her perception of the student learner. This project was not an interpretive study, and I did not seek an answer in my data for my research question: *How does the Subject describe her experiences within the context of a critically transitive pedagogy?* I used my research question as a guide into my analysis to reveal how theories operate for the Subject and influence her interactions with students. This analysis exposed the damaging effects that traditional mathematics practices can have when they confine and control students' mathematical selves. When the Subject changed her teaching practices and provided opportunities for students to foster their unique relationship to mathematics, students displayed more engagement with it.

For this study, I used analytic autoethnography to examine self. I used memory data, memories that were made and re-made, leaving opportunities for misunderstandings or memory loss, and creating holes in my experiences. Although I had lived the experiences I was investigating, I used memories of when I was a child or suffering from personal trauma, so there were ample opportunities for memories to be misrepresented or lost. To account for this issue, I used memories that were highly significant to my transformations, and I included the evidence of those transformations in this report.

There are research methodologies that have researcher influence, but not to the extent of analytic autoethnography. As research and participant of this study, I had a direct effect on the collection and analysis of data. I had most of the data on hand prior to the study beginning, and I had familiarized myself with the data because it was either something I had already written or graded. All data were unique, and provided a foundation for a complex, multiple, self-in-context. Any study conducted on self will incur the same limitation.

Future Research

There is an abundance of literature on student–faculty interactions, but the unique characteristics of a student and faculty have too often been ignored. The students and faculty have both been portrayed as isolated and removed from their context. When students are removed from their context, they can be portrayed as an ideal version of a student learner that submits to all power struggles with the ideal, removed from context faculty. A remedy may be placed on the student, and she submits. She is measured, labeled, categorized, and she submits. The ideal student does not bring her culture or her experiences into the classroom, she must be a representation of all ideal students. There is no resistance from her, nothing that subjects her or controls her opportunities. The studies that have considered conditional effects of students and faculty reveal that these power struggles do exist, but the student is not an isolated, removed from context, split self, and neither is the faculty. More research into the conditional effects of student–faculty interaction is needed, but constructs that examine individuals as multiple selves-in-context are scarce. These constructs are theoretically and empirically underdeveloped (Ernest, 2004), but they could provide helpful theoretical tools to understand how students and faculty have been positioned. Foucault's concept of power relations (e.g., see 1982) can provide theoretical tools that reveal how these multiple selves are confined and constituted, providing a deeper exploration into the influences that manipulate their positioning.

Traditional pedagogies in mathematics are not serving students well. There have been many reforms and initiatives in mathematics education aimed at improving test scores, but these "remedies" seek to change the student in some way so they can become proficient in the procedures presented to them. Students develop an identity based on the labels placed on them while their mathematical relationships are controlled. This type of pedagogy does not provide equitable opportunities for all students, and more research on traditional and nontraditional pedagogical positionings in the mathematics classroom is a needed area of research. The faculty's pedagogical positioning can provide the blueprints for her perception of the student learner and what she values in the mathematics classroom, providing a deeper understanding of the interactions between her and her students. The positioning of students can illuminate how they have been influenced, controlled, and confined, all affecting their interactions and engagement with faculty—and with mathematics.

As my perception of the student learner shifted throughout the years, I experienced the positive student outcomes noted anecdotally throughout this project. The nontraditional methods of a critically transitive pedagogy had an effect on some of the students, so an inquiry stemming from this study would be a longitudinal mix methods study on students who participated in a course with a critically transitive pedagogy. Exploring their perspectives, experiences, and academic outcomes of the course can fill omissions undergraduate mathematics education research. I save that exploration for a future study, but I conclude this study with anecdotal evidence that students enrolled in a course with a critically transitive pedagogy have the possibility to shift their entire perception of their mathematical self:

> I no longer had to be tied to this false identity of being a failure. My living proof of this is in Professor Carmack's class. This class gave me a new chance and a new identity to try. (Student1, NE).

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APPENDICES

APPENDIX A

UWISE Mini-Grant Proposal

Supplemental Instruction (SI) for Math 1111 and Math 1113

Carrie Thielemier

The purpose of this project is to provide students with supplemental instruction to lower student DFW rates in Math 1111 and Math 1113, and to identify students who possess strong math skills as well as show an interest in the discipline. Supplemental Instruction will allow students to attend workshops to identify their weaknesses, recognize and utilize their strengths, and gain a better understanding of core mathematics. It will also give instructors the ability to measure the students' improvement throughout the semester, and recruit strong students to a science, technology, engineering, or mathematics discipline.

Identified Needs:

The current DFW rates for students in Math 1111 and Math 1113 are not where we would like them to be. Below is a table that shows the DFW rates for the past 4 semesters.

SEMESTER	MATH 1111 DFW RATES	MATH 1113 DFW RATES
Fall 2010	41.4%	40.4%
Spring 2011	46.2%	41.2%
Fall 2011	32%	28.4%
Spring 2012	46%	32.6%

National data shows that universities who offer effective supplemental instruction lower the DFW rates for students who attend by over 10%. Below are statistics from Fall 2003–Fall 2006 that shows this decrease.

	DFW rates – Mathematics
Attend SI	24.96%
Do Not Attend SI	35.01%

Copyright University of Missouri – Kansas City, 2007

There is also a shortage of students obtaining a degree in the sciences, technology, engineering, and mathematics disciplines.

Impact:

This project will help students who attend SI sessions to build a strong foundation in their problem solving and critical thinking skills. This will help them excel in their math courses, and also in similar disciplines such as science, engineering, and technology.

Students will have the option to attend several SI sessions per week. At each session, the students will cover topics from their Math 1111 and Math 1113 classes . There will be an SI leader at each session to guide the students in their studies. Students will gain a better understanding of the material and have the opportunity to express this understanding to their peers through group instruction.

Students who readily develop strong math skills and still attend SI sessions will help demonstrate to the instructor that they are strong candidates for receiving a degree in a STEM discipline.

Goals:

There are two goals of this project:

- Lower DFW rates in Math 1111 and Math 1113.
  By attending SI sessions, students will obtain a better understanding of mathematics. This will prevent students from withdrawing or dropping from the class, and increase their overall grade to prevent failing.

- Increase the number of students obtaining a degree in one of the STEM disciplines.
  When students who readily possess strong math skills attend SI sessions, it allows the instructor to identify these students as potential graduates in a STEM discipline. Instructors have the opportunity to recruit these students early in their college career.

  These students show they have the discipline and motivation to be successful in a STEM discipline.

Research Questions:

This project will assess whether the availability of supplemental instruction increases student's overall performance in Math 1111 and Math 1113, as well as determine if this is an effective tool in recruiting students to obtain a degree in a STEM discipline.

Plan:

In order to hold effective SI sessions, we will need to have two SI leaders, one for Math 1111 and one for Math 1113. These leaders will be selected based on their performance as a Mathematics major and their ability to be effective tutors. The student leaders will be assigned at least one class section for each of the above classes.

SI leader responsibilities:

- Attend class to obtain notes and class information from the instructor.
- Hold a minimum of 3 hours of SI sessions a week.
- Hold a minimum of 1 hour of office hours a week.
- Possess a strong understanding of the discipline they are assigned to.
- Maintain a professional attitude and attire while on campus.
- Keep documentation on all students that attend SI sessions, and the dates students attend.
- Report to me once a week to discuss the progress of the program or issues they may have.
- Each SI session will include question/answer instruction, group instruction, and one-on-one/lecture instruction. The instruction will coincide with the instructor's lecture.
- Instructor's responsibility:
- Motivate students throughout the semester to attend SI sessions.
- Keep track of student's progress and consistently collect data.

- Meet with the SI leader once a week to discuss the program.
- Attend a minimum of two SI sessions to evaluate the SI leaders.
- Identify and meet with students who show they are potential candidates for a degree in a STEM discipline.

Evaluation:

To determine the effectiveness of the project, the instructor will give students a non-graded quiz the first week of classes. This will give the instructor a “starting point” for each student. The instructor can then categorize each student into “high risk”, “moderate risk”, and “low risk” of failing the course.

At the end of the semester, I will evaluate the program’s success based on the following:

- The student’s final grade.
- The student’s grade for each exam/final.
- How many SI sessions were attended by each student.
- How many SI sessions were attended by each student for each exam.
- The student’s “starting point” based on the initial quiz.

I will also compare this with students who did not attend SI sessions, their overall grade and each of their exam grades.

Budget:

Summer 2013 Salary	$2500
Funds to pay two SI Leaders	$2800
Total	$5300

Dissemination:

The results of this project will be posted on the campus webpage. If they are impressive, I would like to post flyers where Math 1111 and Math 1113 classes are taught. These flyers will show the average final grade for students who attend a certain number of SI sessions per semester compared with those who attend less or none. I would be very happy to share my results with other instructors so they can notify their students of the benefits of attending SI sessions.

APPENDIX B

Math 1111 – PreQuiz
Carmack
Print your First and Last Name:
____

***Your answers to the following PreQuiz will help me determine your risk of failing the class, and therefore allow me to recommend the best resources for you to be successful in this class. Please answer the questions honestly and to the best of your ability. If you are unsure of your answer, place the following next to your response:** *EST

1) Have you taken College Algebra, as a college credit, before? (either at UWG or another institution) **YES** **or** **NO**

-If you answered YES: What semester and year did you last take it? _______________

How many times did you take it previously? **1** **2** **3 or more**

-If you answered NO: What semester and year was your last math-related class? _____

What was the name of your last math-related class? ______________________

What was your letter (or percentage) grade in your last math class? __________

2) What are you classified as? **Freshman** **Sophomore** **Junior** **Senior**

3) Is your intended major related to the Science, Technology, Engineering, or Math field?

YES **NO** **UNDECIDED**

4) Where did/do you attend High School? ____

5) What year did/will you graduate High School? ___________________________________

6) Do you currently have a scholarship to attend UWG? **YES** **or** **NO**

7) Do you currently feel like you will need a tutor in this class? **YES** **or** **NO**

*Note: you will be able to receive tutoring at any time during the semester for this class, regardless of your answer for this question.

8) Please use the space below to explain how you plan to study for this class and how much time you plan to dedicate to this class each week.

-How you plan to study for this class:

-How much time do plan on dedicating to this class each WEEK: ________________

Answer the following questions to the best of your ability. If you do not know how to find the answer, just leave it blank. DO NOT USE A CALCULATOR.

1) Write the following as a REDUCED fraction: $\frac{12}{28}$	2) Multiply: (15)(1/3)	3) Add: $\frac{2}{3} + \frac{3}{5}$
4) Add/Subtract: -8 – (-5)	5) Add/Subtract: -5 + 8	6) Simplify: $x^2 - 2(x + 1)$ if x=1
7) Multiply: (-4)(-3)	8) Subtract and Collect like terms $(-2x^2 - 3x) - (5x^2 - 2x + 4)$	9) Simplify: $(-2)^3$
10) Multiply: $(x^7)(x^2)$	11) Factor: $x^2 - 2x - 3$	12) Solve: $3x - 1 = 5x + 7$

APPENDIX C

UWise Research Report
The Effects of Supplemental Instruction (SI) on Students' Achievement in College Algebra

Carrie Thielemier

Introduction

Since the spring semester of 2013, I have been collecting and analyzing data to determine how effective attending SI was for increasing Math1111 students' grades. Currently, the DFW rate for Math 1111 is not where we would like it to be. Through this research project, it can be determined that attending SI may help a student increase their overall Math1111 grade, and therefore, lower overall DFW rates for Math1111.

Data was collected for three semesters, Spring and Fall of 2013, and Spring of 2014. During the Spring of 2014, I made some changes to see if there would be a difference in the analysis of the data. Spring and Fall 2013 data was very consistent, and although there was a slight change in Spring 2014, the data remained relatively consistent.

Purpose and Research Questions

The purpose of this project was to assess whether attending SI increased a student's overall course performance. My primary research question *was: What is the effect of SI attendance on MATH 1111 students' course performance compared across level of risk for course failure?* To answer this question, I categorized each student's risk of course failure (high, moderate, or low risk), counted the number of SI sessions each student attended, and then compared course achievement of students at each risk level.

Supplemental Instruction

SI sessions were held for 1 hour, three times a week. Sessions were not mandatory, but students were encouraged to attend. There were at least two SI leaders available for Math 1111 each semester, either provided through the UWise Mini-grant, or through the Excel Center. A student received credit for attending a one-hour session only if they were present for 50 minutes.

SI leaders were required to attend my classes and take my notes. When a student attended SI, they received additional help that coincided with my lecture. Based on the SI leader's instruction technique, this may have involved peer tutoring, working extra problems, or answering student questions. The lecture was not re-taught. Some SI leaders also created study guides to help students practice for the exams. SI leaders did not receive a copy of an exam until after all students had taken it.

Participants

Math 1111 is a freshman level class worth 3 credits. This is a core class that does not require a prerequisite. The class is comprised of mostly traditional students that are within their first year of college. For all three semesters, there were a total of 296 student scores that were analyzed.

Data Collection Strategies

In this study, I relied on quantitative data sources to answer my research question. Quantitative data included number of SI sessions attended, final grade, and risk.

During the Spring and Fall semester of 2013, my class consisted of 4 exams, and I recommended that students attend 5 SI sessions for each exam. However, for Spring of 2014, I increased the number of exams to 5, and recommended that students attend at least 4 SI sessions for each exam. When I analyzed the data separately, the results were very consistent. As a result, I combined all data and analyzed it as a whole.

Number of SI sessions attended. I began the semester by explaining the importance of the student receiving additional help for the class and to attend SI sessions. SI leaders documented attendance and, if a student did not stay at least 50 minutes of the hour, they did not receive credit for attending. Once an exam was given, I collected the attendance sheet from each SI leader and documented the total number of times a student attended.

Final grade. A student's final grade was calculated based on exam scores, quiz scores, and final exam. Quizzes were worth 20% of a student's grade, exams were worth 50%, and the final was worth 30%. The final exam also replaced the lowest test grade and students were never allowed to make up a quiz or exam, regardless of the reason for being absent.

Exams.

Exams varied throughout each semester, but each exam contained 15–20 questions. Questions were a combination of multiple choice, short answer, and fill in the blank. The questions were similar to homework problems, and consisted of formulas, definitions, and terms. Partial credit was given to short answer questions.

Weekly Quiz.

Quizzes were given, on average, once a week and were 10 points each. The quizzes came straight from the homework and were typically 3–5 questions long. At the end of the semester, I dropped the two lowest quiz grades for each student.

Final Exams.

The Math1111 final exam consisted of 40 comprehensive, multiple-choice questions. There was no partial credit given for the exam, and no curve was implemented.

Risk. On the first day of class, I gave students a pre-quiz to determine their risk of failing the class. Determining a student's risk helped to identify what "type" of student was attending SI and allowed me to categorize each student. The pre-quiz for Spring 2014 is provided in Appendix 1.

The pre-quiz contained basic math questions that students were expected to have knowledge of before taking College Algebra, simple algebraic questions of very low difficulty, and questions of moderate difficulty whose concept is taught in the first few weeks of classes. It also contained questions that asked if a student had taken this particular class before (if they had, how many times), and how long it had been since their last Math class. Using the answers students gave on the pre-quiz allowed me to categorize each student as low risk, moderate risk, or high risk of failing the class.

Results

To determine the effect of SI attendance on students' course performance in MATH 1111, I compared final course averages for each risk group (high risk for failing, moderate risk for failing, low risk for failing) based on how many SI sessions students attended. I did not include data from students who failed to take the pre-quiz or final exam. I also excluded data from students who missed at least 40% of lecture.

Table 1 shows the distribution of students being low, moderate, or high risk out of the 296 students analyzed.

Table 1: Distribution of Students Based on Risk Level

Risk Level	Percentage of Students
Low	20%
Moderate	60%
High	20%

Low Risk: Low risk students had an overall average final grade of 86.4%. Table 2 shows the average grades compared to the number of SI sessions attended. There were a total of 60 low risk students analyzed. The data show that very few low risk students fully utilized SI. This indicates that low risk students do not need additional help to perform well in the class.

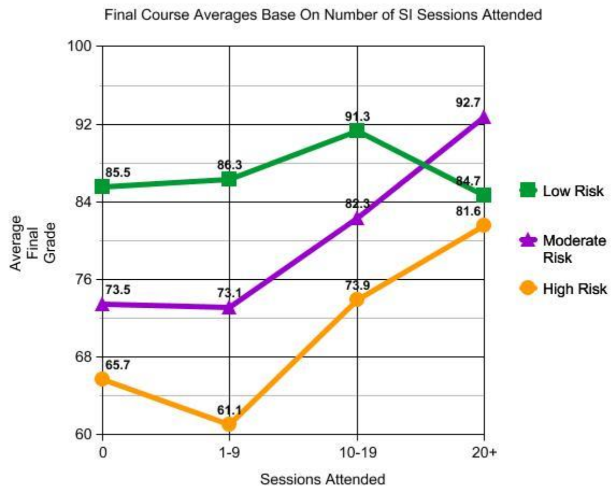
Moderate Risk: Moderate risk students had an overall average final grade of 75.3%. Table 2 shows the average grades compared to the number of SI sessions attended. There were a total of 179 moderate risk students analyzed. The data show that the more a moderate risk student attends SI, the better their final grade. Students who attended 10 or more SI sessions showed approximately a letter grade improvement from those that attended fewer or no times.

High Risk: High risk students had an overall average final grade of 68%. Table 2 shows the average grades compared to the number of SI sessions attended. There were a total of 57 high risk students analyzed. High risk students did not see a significant increase in their final grade until 10 or more SI sessions were attended. There is a decrease in students' grades if they attended 1–9 sessions, compared to attending 0 sessions. This characteristic has been consistent throughout all three semesters.

Table 2: Final Course Averages Based on Number of SI Sessions Attended

Sessions Attended	**Low Risk**		**Moderate Risk**		**High Risk**	
	N	**Final Grade**	**N**	**Final Grade**	**N**	**Final Grade**
20+	1	84.7	8	92.7	5	81.6
10–19	6	91.3	22	82.3	15	73.9
1–9	20	86.3	63	73.1	16	61.1
0	33	85.5	86	73.5	21	65.7

The following is a graph that represents the data in Table 1.



Conclusion

After analyzing data for Math1111, it appears that SI is an effective tool for those who are moderate to high risk students. Students who are low risk may not have to use additional resources to succeed in the class. Students who are high risk may benefit more from one-on-one tutoring if they do not plan to attend 10 or more sessions. It is recommended that moderate risk students also attend more than 10 sessions so that they are more likely to receive a better than average grade.

My end goal is for Math1111 instructors to have the ability to categorize students based on a variety of easily obtainable factors and what resources work best for each categorization. Giving a student this type of information within the first week of class will help them manage their time and understand what is expected for them to succeed. This may also encourage instructors to start incorporating these resources within their class, so students have a much better chance of passing the class with a strong understanding of the topics covered.

My next step in this research project is the focus on high risk students that fall in the 1–9 sessions attended. It is my assumption that these particular students are making some effort but may get discouraged throughout the semester. Although I cannot predict how many SI sessions a student will attend, I can use this data to motivate a student to either attend SI 10 or more times, refer them to tutoring, and keep constant contact with them throughout the semester.

APPENDIX D

Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation
Nomination Packet for the Freshmen Math Program
University of West Georgia

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UNIVERSITY of West Georgia

Division of Academic Affairs
Carrollton, Georgia 30118-4510
Office of the Provost and Vice President

October 29, 2019

Regents' Teaching Excellence Awards Selection Committee
Board of Regents, University System of Georgia
270 Washington Street, SW
Atlanta, GA 30334-1450

Dear Members of the Selection Committee,

On behalf of the University of West Georgia, I am particularly pleased to nominate the Freshmen Mathematics Program for the 2020 Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation. This program is based in the College of Science and Mathematics at UWG and, as the following portfolio will demonstrate, has been making important and influential improvements to academic outcomes for students in their first year of college.

The Freshmen Math Program holds student success at the forefront of what is taught and *how* it is taught. Aware of the evidence corelating success in first-year math and future degree completion, the program faculty have worked consistently to ensure that student learning influences the curricular and instructional decisions made for every section of all courses in the program. These faculty have aligned their work with the goals of the University System of Georgia's Momentum Year, especially in regards to fostering a productive learning environment and promoting a positive growth mindset for students.

In conjunction with the implementation of corequisite learning support courses in math, Freshmen Math program faculty have also built successful support strategies, driven by data on student outcomes, that have yielded demonstrable increases in student achievement in their math courses. These strategies include a range of academic materials to supplement lessons, such as sequences of brief videos that students can access online anytime to better understand difficult concepts. Additionally, to support the Momentum Year focus on purposeful choices, program faculty have incorporated engaging, relevant content into the math course that relates to students' chosen major or academic focus area. These materials connect lessons, activities, and exercises to real-world examples.

Calling on the literature that supports a productive academic mindset, the Freshmen Math Program has revised not only course materials and content but also the supplemental activities that help to support such a mindset. For example, each of the program faculty talks with students—in-class and out—about reframing common assumptions about math that are often the result of experiences in high school math classes. In class, this focus on a growth mindset might take the form of inclusive discussions about attitudes and expectations, or it might appear in repeated encouragement to persist from faculty. Out of class, faculty meet with their students one-on-one to unpack their misperceptions of their own abilities and explore successful study strategies.

These approaches, among others, reflect a central focus within the Freshmen Math Program on the issues that influence student learning and student success. The faculty have actively investigated their assumptions about teaching, exploring pedagogies that advocate for reconsidering the range of experiences, backgrounds, and circumstances that students carry into their classes. For example, to reduce the financial burden of expensive textbooks, the Freshmen Math Program switched to free online books. The program also eliminated a subscription-only online homework platform by choosing a free version that students can readily access. Although requiring significant time upfront to investigate viable, high-quality replacement options, these shifts have removed a recognized barrier to student success.

The University of West Georgia is proud of the continuous efforts and solid results of the Freshmen Math Program. The following portfolio provides compelling evidence for how the program has approached the goals of the USG's Momentum Year—and was doing so before the system-wide initiative began in earnest. The program faculty have risen to the challenge of the Momentum Year, leading to rising indicators of student success. For these reasons and more, I offer my resounding support for the nomination of the Freshman Mathematics program for the 2020 Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation.

Sincerely,

David Jenks
Interim Provost and Vice President for Academic Affairs

INTRODUCTION

The Freshmen Mathematics Program at the University of West Georgia (UWG) is actively engaged in supporting the goals of the University System of Georgia's Momentum Year. The Freshmen Math Program consists primarily of the three large enrollment courses that most of our Freshmen students take in their first semester at the university (MATH 1001 – Quantitative Skills and Reasoning, MATH 1111 – College Algebra, and MATH 1113 – Precalculus) plus the new Learning Support classes that are attached to those courses (MATH 0997 – Support for Quantitative Skills and Reasoning and MATH 0999 – Support for College Algebra). In addition, starting in Fall 2020, the Freshmen Math program at UWG will be a part of the pilot of the Statistics Pathway in the University System of Georgia (USG) and will add MATH 0996 – Support for Elementary Statistics and MATH 1401 – Elementary Statistics to the Freshmen Math Program. The Freshmen Math Program consists of one tenure-track faculty member, who oversees the program as the Director of Freshmen Mathematics, plus 15 non-tenure track faculty members, who almost exclusively teach the Freshmen Math courses.

Across the USG, and in fact nationwide, many students struggle in their Freshmen Math courses, which can lead to low rates of retention, progression, and graduation. As faculty in the Freshman Mathematics Program at UWG, it is our goal to help all of our students succeed in the freshman math courses while we maintain high academic standards. To achieve this goal, we are involved in several initiatives that help students learn and retain the concepts taught in our courses, leading to higher success and retention rates and to lower DFW rates. These initiatives include the following:

Introducing Co-requisite Learning Support courses, which not only include working on the students' mathematics skills but also improve students' academic mindsets;

Offering Group Study sessions, which help students retain the content, build their academic skills, and see connections to other fields;

Striving to cultivate positive student–faculty relationships to break down the barriers to student success;

Engaging in professional development to examine issues related to student learning and effective teaching pedagogy; and

Making several of the course "No Cost" to students by using Open Educational Resources in those courses.

ALIGNMENT WITH MOMENTUM YEAR GOALS

One of the main pillars of the USG's Momentum Year is that students should complete core mathematics and English courses during their first year, including any learning support courses. Seeing as the Freshmen Math Program's goal is to increase student success in our courses, we directly tie into that main pillar.

We are currently teaching multiple sections of two co-remediation courses, MATH 0997 – Support for Quantitative Skills and Reasoning, and MATH 0999 – Support for College Algebra. In addition, we are also part of the USG pilot program seeking to create another co-remediation course MATH 0996 – Support for Elementary Statistics, which we will begin offering next fall. These courses are designed for students with low entrance scores who have traditionally struggled in their first math courses. These students are required to take a two-hour remediation course during the same semester they are taking their first math course. To help these students succeed, we have created academic materials to use in the courses that supplements what we are teaching in the main course. These materials assist students in overcoming difficulties and lets them fill in gaps in their mathematics knowledge. Examples of the materials we have developed include worksheets covering procedural steps and online videos which relate to class lecture. Additionally, we believe that with the proper amount of effort, most students can succeed in their first math course, we just have to convince the students that they can since many lack the confidence in their own abilities due to past struggles with math. Here is a comment from one of the students in our Learning Support course last year, which our students refer to as “lab courses”:

> As a student that struggled in math in High School, I went into college super nervous about taking a College Algebra class since I didn’t do so well in high school. When I heard about the Math Lab class they offered to take while you took the lecture course. I was really excited about it. As the class started, there were times that I needed a little bit of help out of class which were the times I could ask in Lab. Honestly, I feel like you should have to take a Lab with your lecture because I believe students would benefit from this program. Lab consisted of problems that we had learned that day in lecture or have been working on for the week. Lab was treated like tutoring in my opinion and I would recommend this program to anyone.

Another pillar of the System’s Momentum Year is that every student should complete the freshmen mathematics course aligned with their chosen major or meta-major. Currently, the Freshmen Math Program offers 3 courses that students can choose from depending on their major; MATH 1001 – Quantitative Skills and Reasoning, MATH 1111 – College Algebra and MATH 1113 – Precalculus. Beginning in the Fall semester of 2020, we will also give students a fourth option by offering the new Statistics Pathway courses, beginning with MATH 1401 – Elementary Statistics. While much of the material that is covered in the courses is mandated at the system level by the ACMS, we try to emphasize the applications of those topics to the majors of the students that typically take those courses to help students see the relevance of the course to their chosen major. Keeping students engaged in the material by showing its relevance to them and their chosen field of study is a key to making students more successful. For example, in our Precalculus course, we emphasize the applications to the sciences because most of the students in the class are science majors; while in our Elementary Statistics course we tend to focus on medical applications because, currently, a large number of the students are nursing majors. In addition, several of us have begun preliminary discussions with faculty in the College of Business to determine a proper Math Pathway for our business majors because many faculty in both areas feel that the current Pathway of MATH 1111 followed by Math 1413 – Survey of Calculus is not meeting the needs of the Business students. Although these discussions have produced some fruitful results, we have decided to wait until it is determined what the new General Education requirements will be before proceeding further.

PEDAGOGY AND INSTRUCTIONAL STRATEGIES THAT CREATE A PRODUCTIVE ACADEMIC MINDSET

Mathematics education research provides evidence which supports the theory that teachers who implement strategies for a growth mindset improve academic success (Degol et al., 2018; O’

Sullivan & Riordain, 2017; Sun, 2018). As the Freshmen Math faculty worked to create the academic materials for the co-remediation classes, we also wanted to consider this research and emphasize promoting a positive academic mindset. While targeted remediation/review, time for group work, and other forms of academic support were always part of the goal, promoting a positive academic mindset became the thread that tied these together. Historically, when students are asked to describe themselves to math faculty, "I am not good at math" is the most frequent response. This tells us that we have a role to play in fostering a growth mindset to our students.

We decided to incorporate a variety to practices to help promote positive academic mindsets within our students, and here are a few examples that have been used.

i) Each school year, various celebrities will post inspirational videos describing their life experiences for incoming college freshmen. These videos generally describe hardships faced and overcome and look to tell students that they can succeed, even when things get difficult. We like to show these videos to our students because they are promoting growth mindset, and these videos help to make the message stick, especially when it comes from someone they might look up to.

ii) We often take time to have open discussions about attitudes toward math classes (both past and present). We like to hear what the students actually think and believe about themselves, and we work to direct those thoughts in a positive direction. Most of the time, if a student has a negative approach toward math classes, it seems to stem from bad experiences they had in prior classes. We then can work to dispel deep-seated, negative mindset beliefs by pointing toward success in the current class. These discussions are often done in class, but several faculty also invite students in for one-on-one meetings during office hours so these elements can be discussed further.

iii) Another practice that we engage in is discussion of study skills in math classes. The approach to studying in math classes is different than most other subjects. What we are finding to be increasingly true over time is that our students are not coming to us with strong study skills. This problem is exaggerated even further in math classes. It is difficult for students to believe in their abilities and succeed in a class when they do not know how to prepare for it. This is why we take time to have open discussions about study habits and skills. We open the floor up to the students, allowing them to discuss how they study/prepare for the class, and then offer helpful advice as needed. This is a forum for students to learn how to study. There are always a few students who have strong study habits, and their advice is well received by the other students since it is coming from a peer. These conversations are usually strategically timed to coincide with upcoming exams, and they often lead to study groups forming outside of the classroom.

In addition to these strategies, we have started implementing study journal assignments so we may reflect upon current student study data. We rely upon these study journals to address how our own pedagogy matches with student study skills.

DATA-DRIVEN PROCESS FOR REVIEWING AND RESHAPING CURRICULUM

We are constantly reviewing the data that we have available to reshape the curriculum. For example, in MATH 1111 – College Algebra, we administer a common final exam to collectively assess the comprehensive mathematical skills of our students. We analyze the scores to examine how students performed on the final for each topic and how that performance has changed over time. As a result of this data, some of us have re-designed the course into five units based on common themes in the curriculum, instead of merely following the order of the textbook. This redesign has allowed students to make better connections with the content, which has been fragmented for instruction.

In addition, we have been a part of the Gateways to Completion (G2C) project since it began at the University of West Georgia in 2016. While looking at our data for our G2C course, MATH 1113, we quickly realized that one of the factors in determining how our students performed was their Pell eligibility. Students who were Pell-eligible had higher DFW rates in that course than students who were not Pell-eligible. We then looked at our other large enrollment course MATH 1111 and noticed the same trend.

DFWI RATES BASED ON PELL ELIGIBILTY						
YEAR	MATH 1111			MATH 1113		
	Pell Eligible	Not Pell Eligible	DIFFERENCE	Pell Eligible	Not Pell Eligible	DIFFERENCE
2017-18	42.5%	37.9%	4.6%	40.8%	36.3%	4.5%
2016-17	36.2%	35.8%	0.4%	39.6%	31.9%	7.7%
2015-16	33.3%	28.9%	4.4%	33.2%	30.1%	3.1%
2014-15	30.6%	28.9%	1.7%	38.4%	34.0%	4.4%

Additionally, required materials in Math courses can be very costly. For instance, most math textbooks now cost at least $200 and, most of the time, can only be used for one class/semester. Online homework systems that are now commonplace in freshmen math courses are also costly. A large number of our students were not purchasing the required materials for several weeks at the start of the semester and were falling behind. After examining the data, we realized our students may not have been purchasing the materials due to financial difficulties. Therefore, as a result of our G2C work, we began to use free open resources in Fall semester 2018. We are currently using a free textbook in three of our introductory courses, and we are continuously monitoring open resources in hopes of replacing more of our courses with free texts in the future. Also, with a view to making our classes even more affordable for our students, last year several faculty developed courses on MyOpenMath, which is a free online homework program. In the past, we had used MyMathLab, which had the benefit to faculty of already have been developed, even though it cost students about $150/semester. Currently, we have six courses set up in MyOpenMath for all faculty to use. Unlike MyMathLab, in which many students could not set up an account at the beginning of the semester due to cost and could not begin engaging in the content, MyOpenMath allows all students to register into the program immediately and not fall behind.

By using the free, downloadable books and MyOpenMath software, we have saved our students hundreds of dollars each semester. We are proud of our decision to ease the financial burden that required materials can present to students, especially those from marginalized communities. We have tried to keep material costs as low as possible for our introductory courses and will continue to do so in order to give students the best education with the lowest cost possible.

EXAMINATION OF ISSUES RELATED TO STUDENT LEARNING

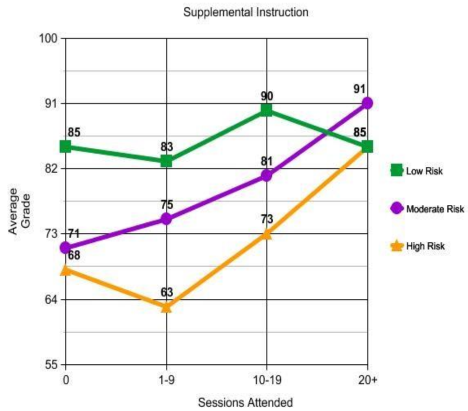
We have been actively involved in adding to the scholarship available in the field and disseminating the results we have had by giving numerous presentations about teaching pedagogy and student success. We have presented at the Mathematical Association of America Southeast Regional meeting, the USG Teaching and Learning Conference, the Georgia STEM Teaching and Learning Conference, and the UWG Innovations in Pedagogy Conference. Many of us also serve as co-PIs for the STEM IV grant "Targeted Interventions in Precalculus and Calculus I," which has been funded by the Board of Regents, starting Fall semester 2019.

In addition, we started a Mathematics Teaching and Learning Reading group this semester to examine issues related to student learning. The first reading is John Dewey's *Experience and Education*, and the first meeting investigated epistemological concerns related to our students' mathematical inquiry, growth, and development of academic mindsets. Future readings will be chosen from the following seminal texts:

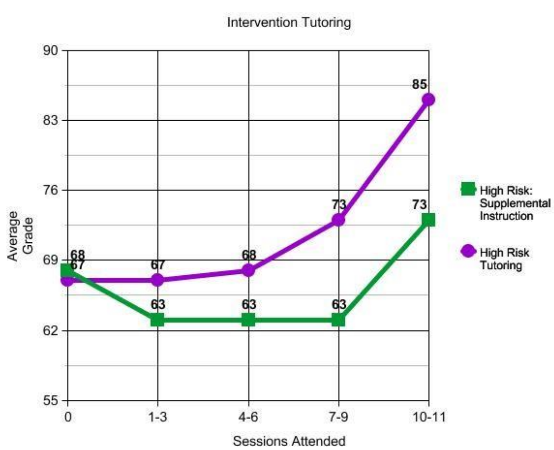
- *What Does Active Learning Mean for Mathematicians?* by Benjamin Braun, Priscilla Bremser, Art M. Duval, Elise Lockwood, and Diana White.
- *Pedagogy of the Oppressed* by Paulo Freire.
- *Social Constructivism as a Philosophy of Mathematics* by Paul Ernest.
- *Transparent Design in Higher Education Teaching and Leadership*, edited by Mary-Ann Winkelmes, Allison Boye, and Susan Tapp.
- *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools* by Joseph Novak.
- *Out of Our Minds: The Power of Being Creative* by Sir Ken Robinson.

USE OF EVIDENCE-BASED STRATEGIES THAT SUPPORT AND FOSTER GROWTH MINDSET

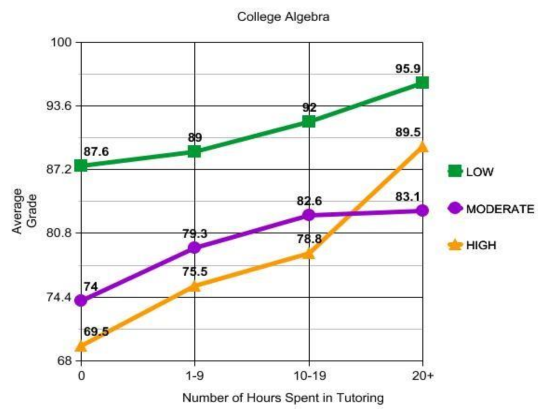
One of the faculty members in the Freshmen Math Program has been conducting ongoing research targeting peer-led group study sessions, which are aimed at improving student success in MATH 1111 and MATH 1113. This research project began in 2013 and was initially designed to measure student success in MATH 1111 when students attend supplemental instruction (SI). For this project, students were given a diagnostic quiz and placed into risk categories based on their performance. Students were marked as having a low, moderate, or high risk of failing the course. The researcher then measured student success in each risk category by comparing student final course grades with number of SI sessions attended. The following graph illustrates the results from 2013 and 2014. Although SI appears to be an effective tool for improving some student grades, this research indicated that not all students benefit from this type of academic support, primarily, high risk students.



The Freshmen Math Program has analyzed the data each semester, and the same trend occurred: high-risk student grades dropped when students attended 1–9 sessions. This was alarming to us because these were students who were trying and they were attending help sessions. We speculated that perhaps these students, after trying and failing, gave up. Therefore, a new program was created for implementation alongside SI so that we could better meet the needs of these students. Intervention tutoring was the result and provided more structure and individualized attention to high-risk students. Sessions were capped at four students, and once signed up, students committed to attending every week for the duration of the semester. The following graph illustrates what happened to student grades after the program was implemented when compared to grades of students that attended only SI in previous semesters. As illustrated, Intervention Tutoring resulted in improved average final grades for students in MATH 1111. The program has continued, and we collected data each semester.



We also decided to open the tutoring program to all students. To promote the program, we began inviting students to our office for short student-teacher meetings. We invited high-risk students first and promoted the tutoring program, along with SI. Then we invited moderate-risk students, and last, low-risk students. Each student who came to our office had the chance to sign up for Intervention Tutoring. The following graph illustrates the results of average final grades compared to number of hours spent in tutoring (including SI).



The results were promising, so we decided to begin offering the tutoring program in MATH 1113. We continued to collect data and saw the same trends in MATH 1113. We renamed the program as Group Study Sessions, and currently, all sections of MATH 1113 are implementing the program in their classes. While the results vary among faculty, we are finding that those faculty who meet with their students, who focus on building a positive relationship with them, and who actively promote peer relationships among students are seeing the best results. Therefore, we are focusing on improving those techniques and pedagogies that do more than provide academic support to students. We are developing the program to provide a community of learning and to allow teachers to consider the social aspect of learning as an important tool for student success. Below we have described this is more detail.

Community of Learning

When students sign up for a Group Study session, they commit to attending that specific study session each week. As a result, students develop a small learning community that targets mathematical content. It is our belief that this type of community encourages creative thought and allows students to improve their mathematical abilities in an environment that is less intimidating than in a large class. This arrangement fits into our epistemological beliefs that knowledge is acquired, not transferred. While traditional mathematics classrooms consisted primarily of lecture, we have strived to provide opportunities for students to be active learners. However, time is limited in a lesson, and in the mathematics discipline, lecture may be necessary to provide procedural steps and explanations for students. Therefore, Group Study sessions create an additional resource for students to engage with the material so they may connect their new knowledge with their prior knowledge, and thus, make better connections with the content introduced during class time.

Social Aspect of Learning

There are plenty of studies in mathematics education that have supported the theory that professor-teacher relationships and learning outcomes are related. For example, when teachers provide motivational support to their students, student engagement improves (Ozkal, 2018; Martin & Collie, 2018; Kiefer, Alley, & Ellerbrock, 2015; Ruzek & Schenke, 2018). As a result, a core component of the Group Study sessions takes this research into consideration. Faculty who implement the Group Study sessions in their MATH 1113 courses are asked to meet with each of their students during office hours during the first few weeks of classes. During this meeting, faculty listen to their students' concerns, they begin a dialogue that supports a growth mindset, and they discuss the various academic support resources available to the student, including the Group Study sessions. We have discovered that during these meetings, barriers that prevented comfortable learning environments are broken, the students begin to see their teacher as an ally that wants to work with them and see them succeed, and a positive professor-student relationship begins to form. These sessions also allow us to assess who our students are, what their backgrounds are, and what their beliefs are on their own mathematical abilities. Therefore, we do not have to rely on broad generalizations based on research studies that did not take place at our university. Rather, we have used this information to develop and modify a program that will best fit our students' needs.

Group Study sessions benefit not only struggling students but also students who do well in the course and enjoy mathematics. The following quotes are from former students who attended Group Study sessions in MATH 1111 and MATH 1113. They describe the program below:

> Mathematics is and has always been my favorite subject. I would say my passion for math is a gift. I want to be able to extend and hence share the gift with the world. Most students have come to believe that math will forever be a tiresome and challenging subject. Due to that, they have a mindset that, regardless of the numerous practices problems they do, they will never understand anything that is math related. Group study sessions motivate students to study. This is because many students derive energy from being around other people and look forward to learning and discussing material with classmates. Moreover, having no understanding of a concept and having no one around to help outside of class can be very frustrating. A major benefit of studying in a group is being asked by classmates if something doesn't make sense. Studying in groups helps to promote creativity and critical thinking. My experience studying in group improved my interpersonal and organization skills. Group study sessions also creates an interactive environment that not only helps to improve knowledge, but also reinforces learning. I had the opportunity to experience group study session and because of it, I have learned a lot and I have been able to extend my gift to other students by providing assistance to students in understanding math concepts and to be able to apply their understanding to any other problem, I have also built excellent communication skills, great valuable work experience, and effective study habits. – Joyce Armah

> I recommend the group tutoring program for a few reasons. First of all, it was a major help in allowing me to catch up on material I had not seen in years. I had just started college five years after I graduated high school, so there was a lot of basic algebra skills that needed to be refreshed in order for me to be able to do well in pre-calculus. The group tutoring provided that extra bit of help that I needed to fully catch up. Secondly, it provided an opportunity for me to meet with other classmates and get to know them. Because of this, I was able to form study groups on top of our tutoring sessions when it came closer to exam time, which helped tremendously. And the third reason being that it was very convenient to have a group expressing what they were struggling with, because sometimes you think you know the material, but you may not fully understand it or you learn new methods of approaching the material. Even if you did understand the material, you would still be provided a review which helped with studying for future exams. The group also allowed everyone to help each other along with the tutor. Teaching and

> helping one another is a very successful way to teach yourself as well. It was also extremely convenient to be able to sign up during a time slot that benefited your schedule. Overall, the program was very helpful and I have no doubt that it enabled me to do well in the class. – Sarah Moore

Because of the encouraging results in Group Study sessions, it is evolving into a more expanded form now called "Complementary Mathematics Instruction" (CMI), which is part of a grant funded through the BOR's STEM IV Initiative. CMI will be utilized in all Spring 2020 Precalculus sections with the goal of expanding it into all Fall 2020 Calculus sections. In addition to the Group Study sessions, students may also sign up for a weekly one-hour workshop. These workshops will not be capped at four students. It is anticipated that as many as 10 to 16 students may sign up for a workshop. The small group tutoring sessions, as before, will focus more on content that the student brings in to discuss; therefore, the small Group Study sessions will tend to be more procedural. However, the goal for the workshops is to focus less on procedure and more on conceptual understanding, emphasizing the applications of the material in the sciences because most of the students in Precalculus and Calculus are science majors. In addition, the workshops will be led by a mathematics graduate student who will often provide the student with prepared content. Because Fall 2019 semester is the first semester in which the workshops were used, only three precalculus sections implemented the workshops (one per section) for a pilot. Our goal is to implement various teaching techniques and assignments in the pilot workshops to determine the best strategies for future workshops.

MOMENTUM-YEAR-DRIVEN TEACHING PHILOSOPHY

As faculty in the Freshman Mathematics Program, we have long been dedicated to cultivating student success by using methods aimed at improving student mindset, by providing academic resources to develop student understanding of content, by collaborating with each other to build our pedagogical skills, and by engaging in strategies aimed at building positive relationships with our students. We choose to apply these approaches intentionally because of our teaching philosophy and how we believe knowledge is acquired. We believe that students learn by connecting their prior knowledge to what is being taught, and that these connections are constructed through engagement of the material, which is best facilitated by social interaction. With these foundational beliefs, we are able to build a network of enthusiastic faculty who have the same end goal: to better the lives of our students through facilitating their mathematical education. We understand that many students deal with stereotype vulnerability and poor academic mindsets that may impact their performance. We understand that students who come from low socioeconomic backgrounds may not have been given the same opportunities as their more privileged peers and thus may be entering the class less prepared. We also understand the new challenges our students face when entering college for the first time, such as poor time management skills, higher rates of anxiety, and added stress due to financial or familial concerns. By building caring relationships and developing our courses in ways that allow students to build their skills and improve upon their weaknesses, we work with our students and help them to overcome their challenges. We strive to teach our students not only the content but also how to be an academic scholar. We teach them that learning is a process which takes time and should be challenging. We set the bar high for our students because we believe they can reach it when they have they support to do so.

CONCLUSION

We are fortunate to belong to an institute that values student learning and recognizes the efforts of the many people who work tirelessly to aid students in obtaining their academic achievements. To be selected as UWG's candidate for the Regents' Momentum Year Award for

Excellence in Teaching and Curricular Innovation is truly an honor. We believe that the Freshman Mathematics Program aligns well with the goals and standards of the University System of Georgia, and we hope our application provides sufficient evidence of our continued hard work and determination. We thank you for your consideration and wish you the best in selecting this year's award winner.

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Dear Regents' Award Committee,

My name is Johnathan Hurkmans, I am currently a non-traditional student sophomore at the University of West Georgia. I am attending college through the G.I Bill after a four-year contract in the Navy. Being out of school for nearly 6 years and the product of the failed MATH 1-3 program, I failed my first semester of Pre-Calculus due to related difficulties. Because of this failure, I was placed in a College Algebra course with an accompanying lab, both led by [INSTRUCTOR].

I was delighted by a wonderful semester of well explained algebra, accompanied with explanatory videos and individualized assistance. I learned the material better than I even had before and I actually found myself interested in learning the algebraic formulas. If it were not for this program, I would not have had the ability to work out the small bits of information that I had forgotten or that never quite clicked.

With a public school system focused on standardized tests, students often focus on regurgitation rather than retention. In my case, this left many odd gaps of missed or forgotten information. I was wonderful to have a semester in which I could work the majority of those out with individualized help, and a plethora or helpful resources. The lab program as instituted and the University of West Georgia has done wonders for understanding of Algebra and needs to grow in resources and awareness so as to assist more students like me who need a little more help to figure everything out.

V/R,

Hurkmans, Johnathan

Dear Committee,

I participated in the group tutoring program in the Fall of 2018. Though I have never been particularly bad at math, I found myself needing some extra help since it had been a few years since I had taken a math class when I entered [INSTRUCTOR]'s Precalculus class that fall. I signed up to participate in the group tutoring as it was a scheduled very small class of about 4-5 of us and gave us extra individual instruction at a set time I could be prepared for each week. The tutor was excellent and offered academic support and new views on the material we were learning that helped not only myself, but the other students who were in the same group as myself. We were able to help each other better understand what was needed to accomplish the problems, and, as a result, made better grades on our exams in the course.

I would highly recommend the group tutoring to anyone who needs a little more individualized aid in a course. The weekly sessions allowed our tutor to get to know us much more personally and help us in ways tailored to how each of us learned best. Additionally, our tutor was excellent about helping relieve some of the stress of homework because we had an environment where we could work together to figure out more difficult problems are go over other examples to better understand.

Thank you for your time, and I hope you choose to continue offering group tutoring at the University of West Georgia. I would love to see the program expanded to include other courses and majors. I know I often find myself wishing I had a group tutor session to attend in my chemistry courses!

OFFICE OF THE PROVOST
AND EXECUTIVE VICE PRESIDENT

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October 18, 2019

Regents' Teaching Award Committee
University System of Georgia Board of Regents

Dear Committee Members,

I am writing to express my support of University of West Georgia's Freshman Mathematics Program for this year's Regent's Momentum Year Award for Excellence in Teaching and Curricular Innovation. I feel uniquely qualified to offer this support for two reasons: I was involved in UWG's mathematics curricular revisions when I served as Assistant Vice Provost for Academic Initiatives at West Georgia, and in my current role as Vice Provost for Academic Initiatives at the University of Idaho I facilitate our campus's Momentum Pathways project.

A core group of West Georgia's gateway math faculty have been involved in course redesign for the last 5 years. They are a dedicated bunch who truly care about student success and have advocated in their department for changing the way content is delivered, offering additional forms of support, and integrating methods for improving academic mindset. While they have been focused on measurables such as decreasing the DFW rate in course like MATH 1111 and 1113, they have also kept their sights on helping students approach their study of math in a different way. This involves changing students' belief about their ability to do math and improving their mathematical self-efficacy, and it also involves helping students understand the usefulness of math outside of the math classroom.

UWG's course redesign process has included working as a learning community to study best practices, visits to successful math centers such as Georgia State's MILE program, analysis of student success data, engaging in professional development on pedagogy, and pilot testing various support strategies such as supplemental instruction, intervention tutoring, and student conferencing. Their program now includes co-requisite support, integrated open education resources to lower textbook and materials cost, group study sessions, class discussions focused on increasing academic mindset and study skills, and complementary instruction that connects what students are learning in class to real world, discipline-specific problems. While this course redesign process was both connected to or supported by Georgia's Gateways to Completion project and Momentum Year, the work of West Georgia's core gateway math faculty began prior to these initiatives, and it was driven by dedicated colleagues who include tenured and non-tenured faculty, instructors, and lecturers. Their accomplishments have been nothing short of remarkable, and I give my strongest endorsement for UWG's Freshman Math Program to be awarded this year's Regent's Momentum Year Award for Excellence in Teaching and Curricular Innovation.

Sincerely,

Cher C Hendricks

Cher Hendricks, Ph.D.
Vice Provost for Academic Initiatives

UNIVERSITY of West Georgia

Division of Academic Affairs Carrollton, GA 30118-4150

Office of the Provost and Vice President

October 29, 2019

Regents' Teaching Excellence Awards Selection Committee

Board of Regents, University System of Georgia

270 Washington Street, SW

Atlanta, GA 30334-1450

Dear Members of the Selection Committee,

I write in support of the Freshman Mathematics Program at the University of West Georgia for the Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation. For the past several years, I have served as West Georgia's institutional liaison for campus initiatives associated with two significant system-wide student success initiatives: Momentum Year (now, Momentum Approach) and Gateways to Completion (G2C). In light of those responsibilities, I have worked closely with faculty and department leaders in the Freshman Mathematics Program on many of the first-year success initiatives described in their application. What I have witnessed consistently over this time is a strategically driven, sustained effort to improve student success in first-year mathematics courses. This success is the result of collaboration at many levels: active faculty engagement in system-wide meetings and training associated with both Momentum and G2C; faculty collaboration on course and assignment design; and active partnerships with units across campus that support faculty development and student success (Center for Academic Success, Academic Advising, and Center for Teaching and Learning). Some of these initiatives emerged through developing alignments with the USG Momentum goals; others are the result of systematic analysis of key performance indicators (KPIs) as part of Gateways to Completion that began with work on MATH 1113 (Survey of Pre-Calculus) which was then extended to other math courses in the core. This commitment to student success, guided by the program's active engagement with these system-wide initiatives, is having an evidence-based impact on student learning and academic progression at West Georgia, especially among student populations that are academically at risk, such as first-generation and Pell-eligible students. For these reasons, I am very pleased to add my support to their institutional nomination.

While there are many facets to the Freshman Mathematics Program's impact on student success, I want to note several that are specifically associated with the USG Momentum Approach. The program has been intentionally engaged in the development of corequisite learning support courses aligned to MATH 1001 and MATH 1111 based on university system criteria for best practices. Faculty in the program learned a lot about successful course design in mathematics courses through their work on G2C, and it has been inspiring to witness how those lessons—both at the course- and assignment-level—have been applied to the alignment of core and corequisite learning support courses. Since West Georgia did not offer learning support courses in any format prior to Momentum, the challenges associated with implementation have been not just pedagogical but logistical as well. This process has been challenging, but faculty and program leadership have been completely committed to the successful implementation of the learning support courses and have actively partnered with other units across campus (Office of the Registrar, Academic Advising, and Student for Academic Success) to ensure that students who require or need these courses are getting the quality instruction and support they need.

The efforts around academic mindset that the program has implemented in all mathematics courses have been even more vital in learning support courses. Academic mindset was an unfamiliar concept to many mathematics faculty at the beginning of this work, certainly not something that had always been part of

their academic or professional training. However, the Freshman Mathematics faculty began seriously to consider and learn about mindset, initially through work on the KPIs associated with Gateways to Completion and later through the USG work on mindset in partnership with the Dana Institute and the Motivate Lab. In fact, mathematics faculty went so far as to work through a second round of KPIs that focused specifically on transparent and inclusive pedagogies in the second year of G2C implementation. These efforts have resulted not just in a deeper understanding of the connection between productive mindset and student success, but also in specific course and assignment redesigns that include strategies for purposefully aligning math content to a student's chosen major or academic focus area through active learning and real-world examples.

Another significant indicator of success aligned to the Momentum Approach has been the program's decision to adopt across multiple core courses free online textbooks and eliminate an expensive, subscription based online homework platform in favor of a free online version. This was a collaborative decision by faculty teaching freshman mathematics and supported by the rest of the mathematics faculty and department leadership. The change initially was prompted by the review of KPIs in the G2C process as faculty concluded that many students enrolled in core Math courses could not afford the textbooks, placing them at risk for successful completion. This work on identifying or, in certain courses, designing, online resources, has been time-intensive, especially when high-quality alternatives are not always available. However, these efforts have had a significant impact on student success in these courses. Faculty in the Freshman Mathematics Program are also partnering with the USG on the implementation of a Statistics Pathway in Core Area A, and the goal is to utilize free online materials in this new core course as well.

While departments and faculty are often resistant to change, the Freshman Mathematics faculty have been an exemplary program in embracing new approaches to course design, teaching, and collaboration to improve student learning. They have not only worked to implement the strategic imperatives linked to the Momentum Approach but also taken to heart its most essential goal: engaging faculty to support student learning. I have found their work inspirational, and we are seeing evidence on campus of other programs following the pathways they have set. I believe this will result in even greater improvement going forward. For these reasons, the Freshman Mathematics program has my strongest support for the 2020 Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation. If you have any additional questions regarding the program's qualifications for this award, please do not hesitate to let me know at either 678-839-6445 or dnewton@westga.edu.

Sincerely,

David W. Newton, Ph.D.

Associate Vice President for Academic Affairs

Faculty Development and Academic Initiatives

University of West Georgia

Tel 678-839-6445 • Fax 678-839-4766

The University System of Georgia • Affirmative Action/Equal Opportunity Institution

APPENDIX E

UNIVERSITY of West Georgia

.

Precalculus

MATH-1113

Fall 2020 Section 03 4 Credits 08/12/2020 to 12/05/2020 Modified 08/06/2020

- **Description**

This course is designed to prepare students for calculus, physics, and related technical subjects. Topics include an intensive study of algebraic and transcendental functions accompanied by analytic geometry and trigonometry. Students cannot receive credit for MATH 1112 and MATH 1113. For more information on this institution's eCore courses, please see http://www.westga.edu/~ecore/

Requisites

Prerequisites:
MATH 1111 Minimum Grade: D or SAT Math 500 or ACT Math 20 Corequisites:

- **Contact Information**

Mathematics Lecturer: Carrie Carmack
Email: ccarmack@westga.edu
Boyd 104B
Office Hours
Monday
Monday, Wednesday, Friday, 9:50 AM to 10:50 AM, Boyd 104B
Monday, Wednesday, 1:00 PM to 1:50 PM, Boyd 104B

- **Materials**

College Algebra and Trigonometry, Abramson, Openstax. Student can download for free at https://openstax.org/details/books/algebra-and-trigonometry. Students should go to "Download a PDF" and download the High Resolution version.

- **Outcomes**

Students should be able to demonstrate:
An understanding of functions and how to graph functions
An understanding of operations on functions including function composition
An understanding of types of functions.
An understanding of rational functions and their graphs, including intercepts and asymptotes
An understanding of how to find the zeros of a polynomial and how to factor polynomials
An understanding of inverse functions and how to find them graphically and algebraically
An understanding of the properties of exponential and logarithmic equations
An understanding of how to solve exponential and logarithmic equations
An understanding of how to find the values of the trigonometric functions from right triangles and circles
An understanding of how to graph the trigonometric functions
An understanding of how to prove trigonometric identities
An understanding of how to use the sum, difference, double-angle and half-angle formulas for sine and cosine
An understanding of how to solve trig equations
An understanding of how to solve triangle using the law of sines and law of cosines
An understanding of polar coordinates and graphs
An understanding of how to analyze and solve applied problems

- **Evaluation**

Criteria

Type	Weight	Notes
Student-Teacher Meeting	5	You will be invited to a virtual student-teacher meeting during the semester. Attending your first meeting will result in a 100% for this assignment.
Homework	50	You will be given a homework assignment for each course Module within the content of CourseDen. Homework assignments will require that you complete the problem(s), show all work to justify your answer, take a picture, and upload all pictures to the correct assignment folder in CourseDen, by the assignments due date. You must ensure that your picture submission is clear and includes all work for full credit. **You may submit any homework assignment late. A late submission will incur a 15-point deduction.** ***If a homework assignment is graded and you performed poorly, you may use the feedback given and resubmit it for a better grade. Homework resubmissions will incur an automatic 15-point deduction.**

Research	45	ASSIGNMENT	DUE DATE
		Research topic with reflection	08/21 by 11:30 pm
		Annotated bibliography #1	9/11 by 11:30 pm
		Annotated bibliography #2	10/02 by 11:30 pm
		Annotated bibliography #3	10/23 by 11:30 pm
		References (APA)	11/06 by 11:30 pm
Final Presentation			12/06 by 11:30 pm

Breakdown

89.5+	**A**
79.5 – 89.4	**B**
69.5 – 79.4	**C**
59.5 – 69.4	**D**
0 – 59.4	**F**

- **Course Policies and Resources**

Academic Dishonesty

Any form of academic dishonestly will be reported to the institution. For a first offense, a failing grade for the assignment will be given (with no opportunity for replacement). A second offense will result in an automatic "F - failing" grade for the course.

- **Institutional Policies**

Academic Support

Accessibility Services: Students with a documented disability may work with UWG Accessibility Services to receive essential services specific to their disability. All entitlements to accommodations are based on documentation and USG Board of Regents standards. If a student needs course adaptations or accommodations because of a disability or chronic illness, or if he/she needs to make special arrangements in case the building must be evacuated, the student should notify his/her instructor in writing and provide a copy of his/her Student Accommodations Report (SAR), which is available only from Accessibility Services. Faculty cannot offer accommodations without timely receipt of the SAR; further, no retroactive accommodations will be given. For more information, please contact Accessibility Services (https://www.westga.edu/student-services/counseling/accessibilityservices.php).

Center for Academic Success: The Center for Academic Success (http://www.westga.edu/cas/) provides services, programs, and opportunities to help all undergraduate students succeed academically. For more information, contact them: 678-839-6280 or cas@westga.edu.

University Writing Center: The University Writing Center (https://www.westga.edu/writing/) assists students with all areas of the writing process. For more information, contact them: 678-839-6513 or writing@westga.edu.

Online Courses
UWG takes students' privacy concerns seriously: technology-enhanced and partially and fully online courses use sites and entities beyond UWG, and students have the right to know the privacy policies of these entities. For more information on privacy and accessibility for the most commonly used sites, as well as technology requirements visit the UWG Online (https://uwgonline.westga.edu/) site.
Students enrolled in online courses can find answers to many of their questions in the Online/Off-Campus Student Guide (http://uwgonline.westga.edu/online-student-guide.php).

If a student is experiencing distress and needs help, please see the resources available at the UWG Cares

(http://www.westga.edu/UWGCares/) site. Online counseling (https://www.westga.edu/student-services/counseling/index.php) is also available for online students.

Honor Code
At the University of West Georgia, we believe that academic and personal integrity are based upon honesty, trust, fairness, respect, and responsibility. Students at West Georgia assume responsibility for upholding the honor code. West Georgia students pledge to refrain from engaging in acts that do not maintain academic and personal integrity. These include, but are not limited to, plagiarism, cheating, fabrication, aid of academic dishonesty, lying, bribery or threats, and stealing.
The University of West Georgia maintains and monitors a confidential Academic Dishonesty Tracking System. This database collects and reports patterns of repeated student violations across all the Colleges, the Ingram Library, and the School of Nursing. Each incidence of academic dishonesty is subject to review and consideration by the instructor and is subject to a range of academic penalties including, but not limited to, failing the assignment and/or failing the course. Student conduct sanctions

range from verbal warning to suspension or expulsion depending on the magnitude of the offense and/or number of offenses.

The incident becomes part of the student's conduct record at UWG.

Additionally, the student is responsible for safeguarding his/her computer account. The student's account and network connection are for his/her individual use. A computer account is to be used only by the person to whom it has been issued. The student is responsible for all actions originating through his/her account or network connection. Students must not impersonate others or misrepresent or conceal their identities in electronic messages and actions. For more information on the University of West Georgia Honor Code, please see the Student Handbook (https://www.westga.edu/administration/vpsa/handbook-code-ofconduct.php).

UWG Email Policy
University of West Georgia students are provided a MyUWG e-mail account. The University considers this account to be an official means of communication between the University and the student. The purpose of the official use of the student e-mail account is to provide an effective

means of communicating important university related information to UWG students in a timely manner. It is the student's responsibility to check his or her email.

Credit Hour Policy

The University of West Georgia grants one semester hour of credit for work equivalent to a minimum of one hour (50 minutes) of in-class or other direct faculty instruction AND two hours of student work outside of class per week for approximately fifteen weeks. For each course, the course syllabus will document the amount of in-class (or other direct faculty instruction) and out-of-class work required to earn the credit hour(s) assigned to the course. Out-of-class work will include all forms of credit-bearing activity, including but not limited to assignments, readings, observations, and musical practice. Where available, the university grants academic credit for students who verify via competency-based testing, that they have accomplished the learning outcomes associated with a course that would normally meet the requirements outlined above (e.g. AP credit, CLEP, and departmental exams).

HB 280 (Campus Carry)

UWG follows University System of Georgia (USG) guidance:
http://www.usg.edu/hb280/additional_information#
(http://www.usg.edu/hb280/additional_information)

You may also visit our website for help with USG Guidance:
https://www.westga.edu/police/campus-carry.php (https://www.westga.edu/police/campus-carry.php)

Mental Health Support: If you or another student find that you are experiencing a mental health issue, free confidential services are available on campus in the Counseling Center. Students who have experienced sexual or domestic violence may receive confidential medical and advocacy services with the Patient Advocates in Health Services. To report a concern anonymously, please go to UWGcares.

ELL Resources

If you are a student having difficulty with English language skills, and / or U.S. culture is not your home culture, specialized resources are available to help you succeed. Please visit the E.L.L. resource page for more information.

COVID-19

Proctored Exams/Online Instruction: Students should be aware and plan ahead for the possibility of having to complete all courses and/or exams online or in a proctored environment. This means talking with your instructors about what minimum technical requirements (software and hardware) will be required should your class move online or a student's personal needs dictate. This also includes making plans for internet access at whatever location participation may occur.

Virtual or in-person proctored exams, if your instructor should require them, may result in an additional cost to the student. Please discuss these details with your instructor or see the information provided here.

Face Coverings: Effective July 15, 2020, University System of Georgia institutions, including the University of West Georgia, will require all faculty, staff, students, and visitors to wear an appropriate face covering while inside campus facilities/buildings where six feet social distancing may not always be possible. Face covering use will be in addition to and is not a substitute for social distancing.

Face coverings are not required in campus outdoor settings where social distancing requirements are met. Anyone not using a face covering when required will be asked to wear one or must leave the area.

Reasonable accommodations may be made for those who are unable to wear a face covering for documented health reasons.

Student FAQs: For more information about UWG COVID-19 guidance for students visit the Student FAQ webpage

(https://www.westga.edu/student-services/health/coronavirus-info/return-to-campus/students-faq-return-to-campus.php).

CMI Workshops

Students will be given an opportunity to attend CMI workshops. These workshops are optional but designed to support students' academic progress throughout the semester. It is highly encouraged that students attend an academic support service available at UWG.

APPENDIX F

Annual Activity Report
January 22, 2021
Drs. Schroer and Sykes,

Attached is my annual report for the year 2020. As we all know, this was a difficult and stressful year for all of us. With the move to online teaching in the Spring semester, then hybrid teaching in the Fall semester, we all had to balance an incredible workload while enduring worries of our safety and that of our students. Over the year, I worked nonstop to develop my courses as best as I could to benefit my students' learning. Below I have summarized my main efforts for this endeavor.

Spring 2020

The move to online instruction during Spring of 2020 presented a new challenge for me. I had never taught an online course (aside from eCore), so I knew I had to build my Math1111 courses from scratch. With 40% of the content remaining to teach when we went online, I had to convert all my lectures to an online format, develop worksheets for students to practice the content, and develop online quizzes and tests to assess their learning. I created 43 lecture videos in a matter of 3 weeks. These videos ranged from 2 minutes to 15 minutes, and from these videos, I created practice handouts (with answer keys).

Summer 2020

I taught a Math1111 class during summer, and with the University still conducting online instruction, I developed the remaining 60% of the course to be online. This gave me about a month to prepare, and during that time, I created over 70 videos with practice worksheets and answer keys to match. In addition, I created 32 quizzes in CourseDen.

Fall 2020

In Fall, I taught Math1111 and Math1113. Thankfully with all my work during Spring and Summer, Math1111 was fully developed for online instruction. However, I had no content developed for Math1113. Continuing with online videos and practice handouts, I created over 40 videos for the content in Math1113. In addition, I assigned homework where students were required to show work. There were 15 homework assignments in the course and students were to take picture and upload their work to CourseDen. Using these photos, I created individual feedback videos for students to assist in their learning.

But the most significant pedagogical change I have made (in what I believe is my entire teaching career) occurred during this semester. While we were forced to make substantial changes to our pedagogical practices to meet the needs of students and overcome challenges caused by the COVID-19 pandemic, and along with the University reorganization and my move to the newly formed Department of General Education, this moment presented itself as an opportunity for me to try something new in an undergraduate mathematics course. I felt I had more autonomy within my new department, and while I was developing my courses for the Fall semester and deciding on my pedagogical approaches, I made the choice to employ an ethnomathematical perspective (Mukhopadhyay et al., 2009) into the curriculum of my PreCalculus course. This ethnomathematical perspective is one that considers students' experiences with mathematics and what they are interested in learning about. I still taught the classical mathematical content, but I eliminated all exams (whose aim was replication) and replaced them with a reading and writing project. This project encouraged students to think about what mathematical learning *is*, to consider social and cultural aspects to mathematics education, and to think about and connect to the mathematics in their everyday lives. During the first class meeting, I asked students for their questions on the reading and writing project. The first question asked was, "Why are we reading and writing in a math class?" I was prepared for this question. I had predicted it would be asked, because I would have questioned it too, just a few years ago.

There is a philosophy of mathematical knowledge that has been privileged in education and in society, and an entire discourse of mathematics education has been created from it. That mathematical knowledge is a purely objective form of knowledge and free from cultural, social, and political influences (Ernest, 2009). This philosophy contributes to the perspective that mathematics is a formal set of practices and procedures that, once understood and applied, provides a validated solution. It is derived from educational theories and practices that hold the modernist assumptions that certainty can exist, mathematical knowledge can validate certainty, and that the objects of mathematics can provide the rationality needed to uncover the reality in which we reside (Ernest, 2004, 2009). Educational theories that hold these modernist assumptions dominated social science research prior to the 1960s (Stinson & Walshaw, 2017); however, they exclude and place limits on knowledge while ignoring the social influences of knowledge production, elaboration, and legitimation (Ernest, 2004**)**. It was not until 1980, when William Higginson proposed that mathematics education research be informed not only by mathematics but also by sociology and philosophy, that educational theories were broadened, and the identity of mathematical knowledge expanded (Stinson & Walshaw, 2017**)**. The broadening of theory in mathematics education allowed educators to more fully understand the social role of schools and the relationships among student and teacher, the influence of culture and economic conditions in mathematics education, and the political and social power that is gained by having access to (self-legitimized) mathematical knowledge (Ernest, 2009). The teaching and learning of mathematics in our schools and universities, however, has been slow to acknowledge mathematics as more than just a formal set of algorithms understood through repetitive problem solving**.** I did not ponder the question "What *is* mathematical *knowledge*?" during the many years of my academic mathematics education, nor, during a decade of teaching undergraduate mathematics, did I consider the question "What *is* mathematical *knowing*?" Within the mathematical discourse dominating mathematics education, mathematical *knowing* is represented by mathematical *replication*. Where mathematics consists of problem sets with a solution, and *knowing* mathematics is following formal procedures to arrive to that solution while articulating the procedure used through a performance-based assessment. I never read about the history and social context of mathematics and mathematics education. I did not consider mathematics to be community or critical knowledge (Mukhopadhyay et al., 2009). I certainly did not consider that access to mathematics education has been used politically as a means of reproducing social and educational inequality by holding students accountable to unjust and unequal standards of mathematics learning (deMarrais & LeCompte, 1999). It took me enrolling in a PhD Mathematics Education doctoral program for these considerations to develop. The dominant discourse of mathematics education lets in little room for philosophical and epistemological differences, but once different philosophical theories of mathematical knowledge and different epistemological theories of mathematics learning were presented to me, it did not take long for me to critique this discourse and to adopt an attitude to challenge it (Valero, 2004). The students that were enrolled in my Precalculus course are a product of this mathematical discourse and could not interpret a mathematics class that involved more than numbers and problem sets. My goal was to present mathematics so my students could think about it in a different way.

To accomplish this, I created a project where students had to select a mathematical topic to research, and then do so. They were required to select sources to read and write about, and also required in the writing assignments were reflections where students were able to think openly about the mathematics they were learning about. They had the opportunity to ponder the questions "What is mathematical *knowledge*?" and "What is mathematical *knowing*?" As the writing assignments were submitted, as I read through them, I was overjoyed. Students were thinking about mathematics *differently*. They were acknowledging mathematics as a part of everyday life, as a part of their culture. The students had a final project where they presented what they learned through the ethnomathematical project. The results were phenomenal.

TEACHING ACTIVITIES

Courses Taught

Spring Semester

Math0999 03Z	**15 enrolled**
Math0999 14Z	**11 enrolled**
Math1111 03Z	**15 enrolled**
Math1111 14Z	**11 enrolled**
Math1111 03	**9 enrolled**
Math1111 14	**10 enrolled**

Summer Semester

Math1111 E91	**14 enrolled**

Fall Semester

Math1111 04	**34 enrolled**
Math1111 11	**23 enrolled**
Math1111 13	**31 enrolled**
Math1113 03	**38 enrolled**

Curriculum development – **created curriculum content for my own classes**.

Professional development – **Doctoral student at Georgia State University (PhD in Teaching and Learning; Mathematics Education), 2017 – present.**

RESEARCH ACTIVITIES

Presentations.

Carmack, C. A., & Sykes, S. (2020, January). ***Educational philosophy and the academic mindset,*** **talk presented at the University System of Georgia Momentum Summit, Athens, Georgia (invited)**

Grant work.

University System of Georgia STEM IV, ***Targeted Interventions in Precalculus and Calculus I,*** **PI: Dr. Scott Gordon; Co-PIs: Carrie Carmack, Kyle Carter, Rick Johnson and**

Drs. Anne Gaquere, Scott Sykes, and David Leach, submitted ($150,000), awarded August 2019 – present.

SERVICE ACTIVITIES

Departmental Service

Member, Freshman Mathematics Committee, 2019 – May 2020
Member, Interdisciplinary Committee, 2020 - present
University, College Service
Member, University College Dean's Advisory Team, 2020-present
Member, Academic Policies Committee, 2019 – present
Other University service
Faculty Fellow, Center for Teaching and Learning, 2017 – May 2020.
Participated in *Ask a Faculty Panel*, July 2020

AWARDS
Regents' Momentum Year Award for Excellence in Teaching and Curricular Innovation; Freshman Mathematics Program, 2020

APPENDIX G

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Precalculus

MATH-1113

Summer 2021 Section 91 4 Credits 06/01/2021 to 07/23/2021 Modified 11/29/2021

Description

This course is designed to prepare students for calculus, physics, and related technical subjects. Topics include an intensive study of algebraic and transcendental functions accompanied by analytic geometry and trigonometry. Students cannot receive credit for MATH 1112 and MATH 1113.

Requisites

Prerequisites:

MATH 1111 Minimum Grade: D or SAT Math 500 or ACT Math 20 Corequisites:

Materials

College Algebra and Trigonometry, Abramson, Openstax. Student can download for free at https://openstax.org/details/books/algebra-and-trigonometry. Students should go to “Download a PDF” and download the High Resolution version.

Outcomes

Students should be able to demonstrate:
An understanding of functions and how to graph functions
An understanding of operations on functions including function composition
An understanding of types of functions.
An understanding of rational functions and their graphs, including intercepts and asymptotes
An understanding of how to find the zeros of a polynomial and how to factor polynomials
An understanding of inverse functions and how to find them graphically and algebraically
An understanding of the properties of exponential and logarithmic equations
An understanding of how to solve exponential and logarithmic equations
An understanding of how to find the values of the trigonometric functions from right triangles and circles

An understanding of how to graph the trigonometric functions
An understanding of how to prove trigonometric identities
An understanding of how to use the sum, difference, double-angle and half-angle formulas for sine and cosine
An understanding of how to solve trig equations
An understanding of how to solve triangle using the law of sines and law of cosines 15. An understanding of how to analyze and solve applied problems

Evaluation

Major Artifact	*See your detailed assessment plan for grading specifics **Failure to submit your major artifact will result in a 2 letter grade penalty**
Minor Artifacts	Minor artifacts will be collected **in** class each day. These artifacts will be a variety of assessments and students will be awarded an overall daily assessment grade of '**pass**' or '**needs improvement**' for the day. If a student misses a day, it is an automatic '**needs improvement**'. Grades may suffer a penalty if a student obtains a '**needs improvement'.** If a student obtains a '**needs improvement'** grade for the following number of days, the grade penalty will occur: day: no penalty days: no penalty if you complete work within 1 week; no submission will result in -5%. days: no penalty if you complete work within 1 week; no submission will result in -5%4-5 days: penalty applied. -10% (upon instructor discretion). 6-7 days: penalty applied. -10%. 8 or more days: third penalty applied – resulting in a failing course grade ('D' or 'F')

GRADE BREAKDOWN

89.5+	A
79.5 – 89.4	B
69.5 – 79.4	C
59.5 – 69.4	D
0 – 59.4	F

Institutional Policies

Academic Support

Accessibility Services: Students with a documented disability may work with UWG Accessibility Services to receive essential services specific to their disability. All entitlements to accommodations are based on documentation and USG Board of Regents standards. If a student needs course adaptations or accommodations because of a disability or chronic illness, or if he/she needs to make special arrangements in case the building must be evacuated, the student should notify his/her instructor in writing and provide a copy of his/her Student Accommodations Report (SAR), which is available only from Accessibility Services. Faculty cannot offer accommodations without timely receipt of the SAR; further, no retroactive accommodations will be given. For more information, please contact Accessibility Services (https://www.westga.edu/student-services/counseling/accessibilityservices.php).

Center for Academic Success: The Center for Academic Success (http://www.westga.edu/cas/) provides services, programs, and opportunities to help all undergraduate students succeed academically. For more information, contact them: 678-839-6280 or cas@westga.edu.

University Writing Center: The University Writing Center (https://www.westga.edu/writing/) assists students with all areas of the writing process. For more information, contact them: 678-839-6513 or writing@westga.edu.

Online Courses

UWG takes students' privacy concerns seriously: technology-enhanced and partially and fully online courses use sites and entities beyond UWG, and students have the right to know the privacy policies of these entities. For more information on privacy and accessibility for the most commonly used sites, as well as technology requirements visit the UWG Online (https://uwgonline.westga.edu/) site.

Students enrolled in online courses can find answers to many of their questions in the Online/Off-Campus Student Guide (http://uwgonline.westga.edu/online-student-guide.php).

If a student is experiencing distress and needs help, please see the resources available at the UWG Cares

(http://www.westga.edu/UWGCares/) site. Online counseling (https://www.westga.edu/student-services/counseling/index.php) is also available for online students.

Honor Code

At the University of West Georgia, we believe that academic and personal integrity are based upon honesty, trust, fairness, respect, and responsibility. Students at West Georgia assume responsibility for upholding the honor code. West Georgia students pledge to refrain from engaging in acts that do not maintain academic and personal integrity. These include, but are not limited to, plagiarism, cheating, fabrication, aid of academic dishonesty, lying, bribery or threats, and stealing.

The University of West Georgia maintains and monitors a confidential Academic Dishonesty Tracking System. This database collects and reports patterns of repeated student violations across all the Colleges, the Ingram Library, and the School of Nursing. Each incidence of academic dishonesty is subject to review and consideration by the instructor and is subject to a range of academic penalties including, but not limited to, failing the assignment and/or failing the course. Student conduct sanctions range from verbal warning to suspension or expulsion depending on the magnitude of the offense and/or number of offenses.

The incident becomes part of the student's conduct record at UWG.

Additionally, the student is responsible for safeguarding his/her computer account. The student's account and network connection are for his/her individual use. A computer account is to be used only by the person to whom it has been issued. The student is responsible for all actions originating through his/her account or network connection. Students must not impersonate others or misrepresent or conceal their identities in electronic messages and actions. For more information on the University of West Georgia Honor Code, please see the Student Handbook (https://www.westga.edu/administration/vpsa/handbook-code-ofconduct.php).

UWG Email Policy

University of West Georgia students are provided a MyUWG e-mail account. The University considers this account to be an official means of communication between the University and the student. The purpose of the official use of the student e-mail account is to provide an effective means of communicating important university related information to UWG students in a timely manner. It is the student's responsibility to check his or her email.

Credit Hour Policy

The University of West Georgia grants one semester hour of credit for work equivalent to a minimum of one hour (50 minutes) of in-class or other direct faculty instruction AND two hours of student work outside of class per week for approximately fifteen weeks. For each course, the course syllabus will document the amount of in-class (or other direct faculty instruction) and out-of-class work required to earn the credit hour(s) assigned to the course. Out-of-class work will include all forms of credit-bearing activity, including but not limited to assignments, readings, observations, and musical practice. Where available, the university grants academic credit for students who verify via competency-based testing, that they have accomplished the learning outcomes associated with a course that would normally meet the requirements outlined above (e.g. AP credit, CLEP, and departmental exams).

HB 280 (Campus Carry)

UWG follows University System of Georgia (USG) guidance:
http://www.usg.edu/hb280/additional_information#
(http://www.usg.edu/hb280/additional_information)

You may also visit our website for help with USG Guidance:
https://www.westga.edu/police/campus-carry.php (https://www.westga.edu/police/campus-carry.php)

Mental Health Support

If you or another student find that you are experiencing a mental health issue, free confidential services are available on campus in the Counseling Center. Students who have experienced sexual or domestic violence may receive confidential medical and advocacy services with the

Patient Advocates in Health Services. To report a concern anonymously, please go to UWGcares.

ELL Resources

If you are a student having difficulty with English language skills, and / or U.S. culture is not your home culture, specialized resources are available to help you succeed. Please visit the E.L.L. resource page for more information.

COVID-19

Proctored Exams/Online Instruction: Students should be aware and plan ahead for the possibility of having to complete all courses and/or exams online or in a proctored environment. This means talking with your instructors about what minimum technical requirements (software and hardware) will be required should your class move online or a student's personal needs dictate. This also includes making plans for internet access at whatever location participation may occur.

Virtual or in-person proctored exams, if your instructor should require them, may result in an additional cost to the student. Please discuss these details with your instructor or see the information provided here.

Face Coverings: Effective July 15, 2020, University System of Georgia institutions, including the University of West Georgia, will require all faculty, staff, students, and visitors to wear an appropriate face covering while inside campus facilities/buildings where six feet social distancing may not always be possible. Face covering use will be in addition to and is not a substitute for social distancing.

Face coverings are not required in campus outdoor settings where social distancing requirements are met. Anyone not using a face covering when required will be asked to wear one or must leave the area.

Reasonable accommodations may be made for those who are unable to wear a face covering for documented health reasons.

Student FAQs: For more information about UWG COVID-19 guidance for students visit the Student FAQ webpage

(https://www.westga.edu/student-services/health/coronavirus-info/return-to-campus/students-faq-return-to-campus.php).

☐ Additional Items

CONTENT SCHEDULE	6/3 U1.M[A].1 – What is a Function? U1.M[A].2 – Evaluating Functions
6/8	6/10

U1.M[A].3 – Domain & Range U1.M[A].4 – Transforming Functions	U1.M[B] – Common Functions and Their Characteristics
6/15 U2.M[A] – Inverse Functions U2.M[B] – Logarithmic Functions	6/17 U2.M[B] – Logarithmic Functions U2.M[C] – Exponential Functions
6/22 U2.M[C] – Exponential Functions	6/24 U3.M[A] – Right Angle Trigonometry
6/29 U3.M[B] – Foundations of Trigonometry	7/1 U3.M[C] – Graphing Trig Equations
7/6 U4.M[A] – Verifying Trig Identities	7/8 U4.M[B] – Formulas of Trig
7/13 U4.M[C] – Solving Trig Equations	7/15 U4.M[D] – Solving Oblique Triangles U4.M[E] – Polar Coordinates
7/20 - Notebooks Due	7/22 Student Presentations

Attendance Policy

Students are required and expected to attend class to show support. Failure to attend will result in a 'needs improvement' assessment grade and may incur grade deductions.

APPENDIX H

UNIVERSITY of West Georgia

Main Campus

College Algebra

MATH-1111

Fall 2021 Sections 06, 06Z 3 Credits 08/11/2021 to 12/10/2021 Modified 10/26/2021

Description

This course is a functional approach to algebra that incorporates the use of appropriate technology. Emphasis will be placed on the study of functions and their graphs. This includes linear, quadratic, piece-wide defined, inequalities, rational, polynomial, exponential, and logarithmic functions. Appropriate applications will be included. Credit for Math 1111 is not allowed if the student already has credit for Math 1113 or higher.

Requisites

Prerequisites:

Learning Support Math 1: 3 or MATH 1001 Minimum Grade: D or MAT 150 Minimum Grade: D or MATH 1101 Minimum Grade: D or MATH 1113 Minimum Grade: D or MATH 1634 Minimum Grade: D or MAT 151 Minimum Grade: D or MAT 262 Minimum Grade: D or MATH 1401 Minimum Grade: D Corequisites:

Contact Information

Lecturer: Carrie Carmack

Office Hours

Monday, Wednesday, 12:00 PM to 1:00 PM, Boyd 104 - Face/to/face

- By appointment only. Please email to schedule an appointment:

Monday, Wednesday, 1:00 PM to 1:45 PM, Boyd 104 - Face/to/face

- OPEN office hours: no appointment needed/walk in.

Tuesday, 9:00 AM to 11:00 AM, VIRTUAL

- By appointment only.

  Email to schedule an online appointment: carmack@westga.edu

Materials

College Algebra and Trigonometry, Abramson, Openstax. Student can download for free at https://openstax.org/details/books/algebra-and-trigonometry . Students should go to “Download a PDF” and download the High Resolution version.

Outcomes

Students should be able to demonstrate:

Express relationships using the concept of a function and use verbal, numerical,

graphical and symbolic means to analyze a function.

Model situations from a variety of settings by using polynomial, exponential and logarithmic functions.

Manipulate mathematical information, concepts, and thoughts in verbal, numeric, graphical, and symbolic form while solving a variety of problems which involve polynomial, exponential or logarithmic functions.

Apply a variety of problem-solving strategies, including verbal, algebraic, numerical, and graphical techniques, to solve multiple-step problems involving polynomial, exponential, logarithmic equations and inequalities and systems of linear equations.

Shift among the verbal, numeric, graphical, and symbolic modes in order to analyze functions.

Use appropriate technology in the evaluation, analysis, and synthesis of information in problem-solving situations.

Evaluation

Criteria

Type	Weight	Notes
Final Exam	40	• The final exam will be administered on: Monday, **December 6, 2:00PM - 4:00PM**. • It will be a 40 question, multiple choice exam. • **The final exam will be used for the general education assessment for Fall 2021.**
Midterm Exam	30	The midterm exam will be administered on: **October 11**, during regular class time.
Student essay	30	• Student essays are due on: **November 19, 2021**

Breakdown

Grade	Range
A	89.5+
B	79.5 - 89.4
C	69.5 - 79.4
D	59.5 - 69.4
F	0 - 59.4

Assignments

The following course assignments will be administered to students for additional points to be added to the midterm exam, essay, and final exam:

	Total Points	Individual assignments	
Midterm Exam BONUS	**15 pts MAX** 20 pts available	Class Participation (up to 8 pts)	Notes #1 (1 pt)
		Homework #1 (1 pt)	Notes #2 (1 pts)
		Homework #2 (1 pt)	Notes #3 (1 pt)
		Homework #3 (1 pt)	Notes #4 (1 pt)
		Homework #4 (1 pt)	Weekly Reflections (up to 4 pts)
Essay BONUS	**10 pts MAX** 10 pts available	Minor Essay #1 (5 pts)	Minor Essay #2 (5 pts)
Final Exam BONUS	**15 pts MAX**	Class Participation (up to 8 pts)	Notes #5 (1 pt)

	24 pts available	Mathematical writing #1 (3 pts)	Notes #6 (1 pt)
		Mathematical writing #2 (3 pts)	Reflections (up to 2 pts)
		Homework #5 (1 pt)	Art Project (4 pts)
		Homework #6 (1 pt)	

Course Policies and Resources

Academic Dishonesty

Any form of academic dishonesty will result in a failing grade for the assignment and you will be reported to the institution. A second offense will result in failure of the course.

Institutional Policies

Academic Support

Accessibility Services: Students with a documented disability may work with UWG Accessibility Services to receive essential services specific to their disability. All entitlements to accommodations are based on documentation and USG Board of Regents standards. If a student needs course adaptations or accommodations because of a disability or chronic illness, or if he/she needs to make special arrangements in case the building must be evacuated, the student should notify his/her instructor in writing and provide a copy of his/her Student Accommodations Report (SAR), which is available only from Accessibility Services. Faculty cannot offer accommodations without timely receipt of the SAR; further, no retroactive accommodations will be given. For more information, please contact Accessibility Services (https://www.westga.edu/student-services/counseling/accessibilityservices.php).

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University Writing Center: The University Writing Center (https://www.westga.edu/writing/) assists students with all areas of the writing process. For more information, contact them: 678-839-6513 or writing@westga.edu.

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The incident becomes part of the student's conduct record at UWG.

Additionally, the student is responsible for safeguarding his/her computer account. The student's account and network connection are for his/her individual use. A computer account is to be used only by the person to whom it has been issued. The student is responsible for all actions originating through his/her account or network connection. Students must not impersonate others or misrepresent or conceal their identities in electronic messages and actions. For more information on the University of

West Georgia Honor Code, please visit the Office of Community Standards (https://www.westga.edu/administration/vpsa/ocs/index.php) site.

UWG Email Policy

University of West Georgia students are provided a MyUWG e-mail account. The University considers this account to be an official means of communication between the University and the student. The purpose of the official use of the student e-mail account is to provide an effective means of communicating important university related information to UWG students in a timely manner. It is the student's responsibility to check his or her email.

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(http://www.usg.edu/hb280/additional_information)

You may also visit our website for help with USG Guidance:
https://www.westga.edu/police/campus-carry.php (https://www.westga.edu/police/campus-carry.php)

Mental Health Support

If you or another student find that you are experiencing a mental health issue, free confidential services are available on campus in the Counseling Center. Students who have experienced sexual or domestic violence may receive confidential medical and advocacy services with the Patient Advocates in Health Services. To report a concern anonymously, please go to UWGcares.

ELL Resources

If you are a student having difficulty with English language skills, and / or U.S. culture is not your home culture, specialized resources are available to help you succeed. Please visit the E.L.L. resource page for more information.

COVID-19

The health and safety of our students, faculty, and staff remain the University of West Georgia's top priority.

For the most recent information on coronavirus disease (COVID-19) visit:

- UWG's Guidance on Face Coverings (https://www.westga.edu/coronavirus-info/return-to-campus/faq/what-is-the-guidanceon-the-use-of-face-coverings.php)
-
- Centers for Disease Control and Prevention FAQ
(https://www.cdc.gov/coronavirus/2019-ncov/faq.html)

Georgia Department of Public Health (https://dph.georgia.gov/)

APPENDIX I

Hey Student1!
I hope you are doing well and having a great fall semester!

I am reaching out today because I am looking to find participants for my dissertation study, entitled *Re-membering student–faculty interaction within a critically transitive pedagogy: A re-retelling of an undergraduate mathematics instructor.*

For this study, I am interested in exploring our interactions while you were enrolled in our precalculus course. At most, I'll conduct two interviews (face-to-face), lasting no more than 1 hour each. I'm mainly just interested in hearing your perspective and experiences during our class. Your participation will be confidential, and I will take precautions so your identity will remain confidential. Also, I will be the only person with access to our interviews.

I am hoping to start scheduling interviews next week.
If you are willing to participate, just let me know by the end of the week and I'll get back to you.

Oh, and also, I will have to get 'official' consent from my participants to be a part of the study. I have attached the form that will be used, and you'll be asked to sign it during our first meeting. I wanted you to have the ability to look at it first.

I hope to hear from you soon!
Thanks a bunch for any consideration.

APPENDIX J

UWise Research Report

The Effects of Intervention Tutors on High-Risk Students' Achievement in College Algebra

Carrie Thielemier

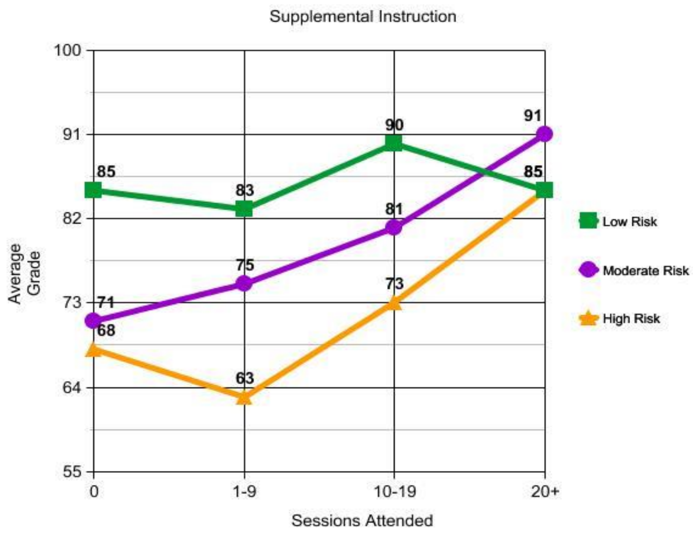
Summary

During the Fall of 2014, students in Math1111 who were categorized as High-Risk were invited to attend Intervention Tutoring sessions held weekly. The High-Risk students that consistently attended tutoring sessions had a positive experience and grades were positively impacted. Evidence shows that attending Intervention Tutoring is a more effective resource for High-Risk students than attending Supplemental Instruction, and placing High-Risk students into Intervention Tutoring at the beginning of the semester will result in much higher grades.

Introduction

Since the spring semester of 2013, I have been collecting and analyzing data to determine how effective attending SI was for increasing Math1111 students' grades. I analyzed each semester individually to check for consistent data, and since the data was indeed consistent, I grouped it all together and analyzed all data values.

At the beginning of each semester, students would be categorized as Low Risk, Moderate Risk, or High Risk of failing the class. Students were then asked to attend Supplemental Instruction (SI). The number of times a student attended SI was compared to the average final grade for each Risk Category. The graph below is a visual representation of what has occurred.



The data shows that students who were Low-Risk of failing the class did not need to attend SI. All average grades were good, regardless of how often a student attended.

Evidence shows that the more often a Moderate Risk student attends SI, the better the final average grade is. It seems SI is most effective for students who fall into a Moderate Risk category.

High Risk students must attend SI often to see a significant increase in their grades. Also, students that attended SI 1-9 times actually had a drop in grades. This dropped occurred each semester, which is why

Intervention Tutoring was implemented. I wanted to shift my focus on High-Risk students and determine if another resource was more beneficial.

Purpose and Research Questions

The purpose of this project was to assess whether targeting High-Risk students and implementing Intervention Tutoring improved their overall performance. My primary research question *was: Is Intervention Tutoring a more effective resource for increasing High-Risk students' grades than Supplemental Instruction?*

Methodology

Intervention Tutoring

Intervention Tutoring was offered to all students who were categorized as High-Risk. Once a High-Risk student signed up for Intervention Tutoring, they attended a session for 1 hour each week. Sessions had no more than 4 students and were led by a peer tutor. During each session, students could ask questions and receive one-on-one help from the tutor.

Intervention Tutors

Intervention Tutors were required to submit weekly updates summarizing how each student did in each session. They were encouraged to submit information on how the student was progressing academically, the student's attitude toward the content, class, or instructor, and attendance of each student.

There were two Intervention Tutors for the class. One tutor began during the first week of classes for students who were categorized as High-Risk based on their Pre-Assessment. The second tutor was added after the first two exams were given. Students who had an average of 65% or lower on their first two exams were then categorized as High-Risk and were asked to sign up for tutoring.

Participants

Math 1111 is a freshman level class worth 3 credits. This is a core class that does not require a prerequisite. The class is comprised of mostly traditional students that are within their first year of college. There were 33 High Risk students analyzed for this project over one semester.

Data Collection Strategies

In this study, I relied on quantitative data sources to answer my research question. Quantitative data included High-Risk students' final grade and the number of Tutoring sessions attended.

Pre-Assessment.

Students were given a Pre-Assessment on the first day of class. The Pre-Assessment contained basic math questions that students were expected to have knowledge of before taking College Algebra, simple algebraic questions of very low difficulty, and questions of moderate difficulty whose concept is taught in the first few weeks of classes. It also contained questions that asked if a student had taken this particular class before (if they had, how many times), and how long it had been since their last Math class. Using the answers students gave on the Pre-Assessment allowed me to categorize each student as Low Risk, Moderate Risk, or High Risk of failing the class.

Students were then asked to email me (the instructor) to get their Risk Category. Students who were Low or Moderate Risk were sent a PDF (Appendix A) that gave my recommendations on what they should be doing in the class to be successful. SI was promoted for these students, and they were encouraged to attend sessions regularly.

Students who were categorized as High-Risk were asked to come to my office so we could discuss their options. They were then asked to sign up for Intervention Tutoring.

Number of Tutoring sessions attended. A High-Risk student that signed up for Intervention Tutoring was required to attend the same session time each week for one hour. They received credit for attending only if they were in the session for 50 minutes of the full hour. Students who missed three tutoring sessions, or missed three class lectures were pulled from tutoring.

Final grade. A student's final grade was calculated based on exam scores, class participation, and a final exam. Class participation was worth 20% of a student's grade, exams were worth 50%, and the final was worth 30%. The final exam also replaced the lowest test grade and students were never allowed to make up class participation or an exam, regardless of the reason for being absent.

Exams. Exams varied throughout each semester, but each exam contained 15-20 questions. Questions were a combination of multiple choice, short answer, and fill in the blank. The questions were similar to homework problems, and consisted of formulas, definitions, and terms. Partial credit was given to short answer questions.

Class Participation. Class Participation was given randomly throughout the semester. The student had to be in class to receive credit. Class Participation mainly consisted of either attendance, or completion of in-class handouts that covered that day's content.

Final Exams. The Math1111 final exam consisted of 40 comprehensive multiple-choice questions. There was no partial credit given for the exam, and no curve was implemented.

Results

To determine if Intervention Tutoring was a more effective resource for increasing High-Risk students' grades than Supplemental Instruction, I compared final course averages of High-Risk students that attended SI in previous semesters to the High-Risk students' grades that attended tutoring during Fall 2014. I did not include data from students who failed to take the final exam. There were 33 High-Risk students in Fall 2014. There were a total of 11 weekly tutoring sessions for each student.

Table 1 shows the distribution of number of Intervention Tutoring sessions attended, number of students attending, and average final grade for all High-Risk students.

Table 1.

Number of Intervention Tutoring Sessions Attended	Number of Students Attending	Average Final Grade
0	17	66.5%
1 - 3	3	67.1%
4 - 6	6	67.2%
7 - 9	2	73.2%
10 - 11	5	84.8%

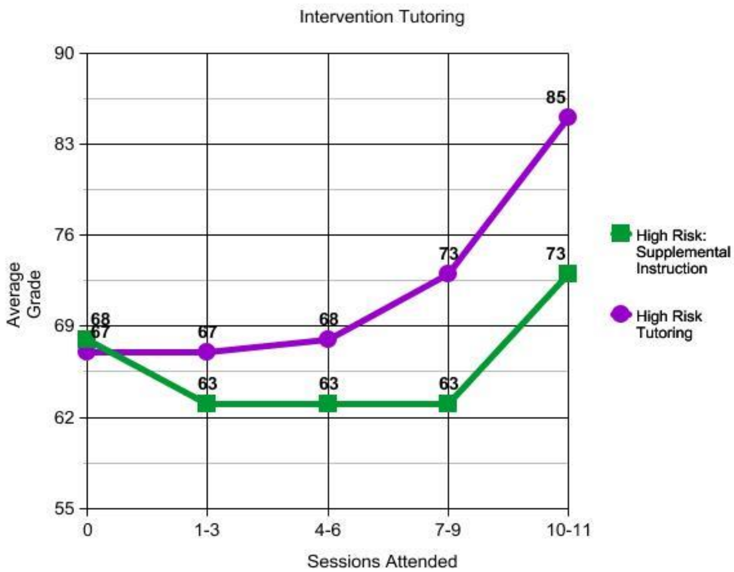
I then compared these results to High-Risk students' average final grades that attended Supplemental Instruction in previous semesters. Table 2 gives the data for High-Risk students' number of SI sessions attended (in previous semesters), number of Intervention Tutoring sessions attended (Fall 2014) and final average grade for each.

Table 2.

Supplemental Instruction		Intervention Tutoring	
Number of sessions Attended	**Average Final Grade**	**Number of Sessions Attended**	**Average Final Grade**
0	68%	0	66.5%
1-9	63%	1-3	67.1%
		4-6	67.2%
		7-9	73.2%
10-19	73%	10-11	84.8%

Table 3 illustrates the data from above.

Table 3.



It shows that Intervention Tutoring is a more effective resource for increasing High-Risk Student grades than Supplemental Instruction. There was no drop in data for Tutoring that we saw for Supplemental Instruction. In addition, students that attended Tutoring for the entire semester saw an average final grade of 85%. High-Risk students had to attend approximately 20 SI sessions to have the same average final grade. The more often a High-Risk student attended tutoring, the better their average final grade.

Conclusion

After analyzing High-Risk student data for Math1111, it appears that Intervention Tutoring is an effective resource for increasing student performance. In addition, it is a better resource for High-Risk students than Supplemental Instruction.

My end goal is for Math1111 instructors to have the ability to categorize students into a risk category based on a variety of easily obtainable factors and promote the appropriate resource for each risk category. Giving a student this type of information within the first week of class will help them manage their time and understand what is expected for them to succeed. This may also encourage instructors to start incorporating these resources within their class, so students have a much better chance of passing the class with a strong understanding of the topics covered.

Currently there are plans to scale up this project at UWG. Six Mathematics faculty who are teaching College Algebra, or PreCalculus, will be utilizing these techniques within their classes during Fall 2015. This will help us determine if the method of categorizing students and promoting most effective resources will be valuable in classes other than mine. We are hopeful that this will lower DFW rates and create a more successful and happier student at UWG.

APPENDIX K

UWise Research Report

The Effects of Supplemental Instruction and Intervention Tutoring on Students' Achievement in College Algebra and PreCalculus

Carrie Carmack

Summary

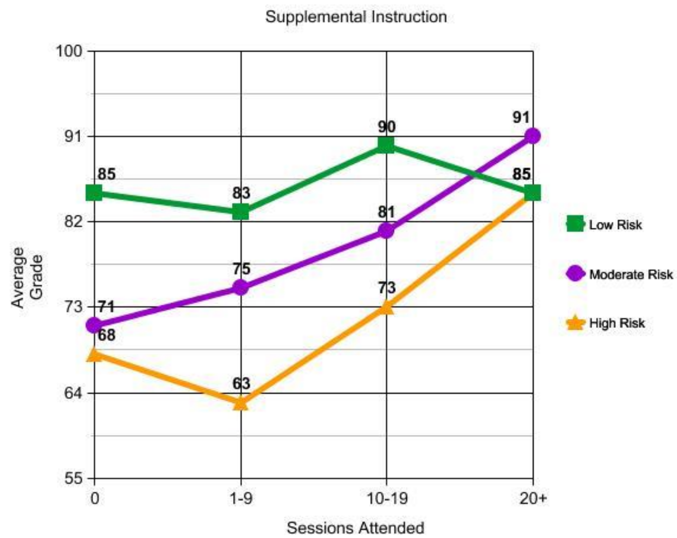
For this UWise project, I measured the effectiveness of implementing a tutoring program and promoting on campus resources in Math1111 and Math1113 to increase student success. At the beginning of each semester, I asked my students to take a PreQuiz that measured their risk of failing the class. I then classified students as High Risk, Moderate Risk, and Low Risk of failing the class. Students I classified as High Risk, or students I classified as Low/Moderate Risk but indicated they would like a tutor, were encouraged to sign up for Intervention Tutoring. In addition, I encouraged all students to attend Supplemental Instruction throughout the semester to help with retention of information. The number of hours spent attending these sessions was compared to students' average final grade for each risk category to determine if attending these help sessions were effective in increasing grades. The data shows that implementing this technique makes an impact on student success in Math 1111. However, some students in Math1113 did not show a significant improvement in increasing student success using this model.

Progress Report

Spring 2013 - Spring 2015

During the first week of classes, my students in Math1111 were given a PreQuiz, that I had developed, so their risk of failing the class could be determined. Based on the PreQuiz scores, I categorized the students and placed them in a risk category: Low Risk, Moderate Risk, or High Risk. During the semester, I promoted Supplemental Instruction (SI) to my students and encouraged them to attend the sessions. At the end of each semester, I compared average final grades of each risk category to the number of SI sessions attended. Each semester had similar results, so the three semesters were analyzed into one measurement, below.

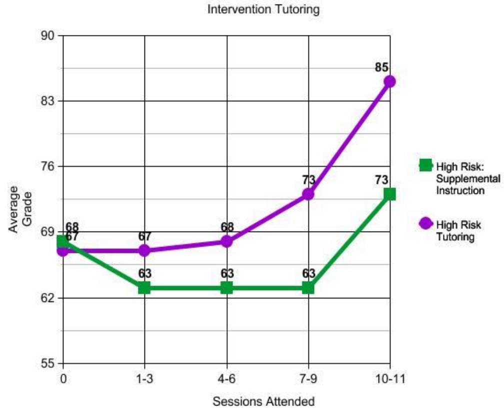
Supplemental Instruction shows to be a highly effective resource for increasing Moderate Risk student grades for Math1111. Below is a graph that illustrates the results of average final grades in Math1111 based on Supplemental Instruction attendance during Spring 2013, Fall 2013, and Spring 2014.



The results also show Supplemental Instruction is not effective for some High Risk students, and there is a drop in average final grades when 1-9 SI sessions are attended. Therefore, I decided to incorporate another help strategy to target High Risk students in Math1111. In addition to promoting SI, I implemented Intervention Tutoring for High Risk students during the Fall semester of 2014, Fall semester of 2015, and Spring semester of 2016 for Math 1111 and Math 1113.

Intervention Tutoring
For Fall 2014, students in Math1111 that were categorized as High Risk were asked to meet with me to discuss opportunities for tutoring. I encouraged them to sign up for Intervention Tutoring, a 4-student group help session that is led by a peer tutor. Students that wanted to attend signed up for one weekly session that lasted for one hour and continued for the duration of the semester. The peer tutors were chosen by me and had either been a former SI leader, or former student of mine.

I compared average final grades of students that attended SI in previous semesters to the average final grades of students that attended Intervention Tutoring. The graph below illustrates the results.



The data shows that High Risk students in Math1111 perform significantly better if they attend Intervention Tutoring compared to if they attend SI. Both resources are helpful, however, Intervention Tutoring is more effective for increasing High Risk students average final grades, and SI is more effective for increasing Moderate Risk students average final grades.

Introduction

I implemented this project so students in Math1111 could have a significant improvement in grades, and as a result, DFW rates would lower, and retention would increase for those classes. I also decided to apply these practices in Math1113 during Spring 2016 to determine if attending SI/Tutoring improved student grades. In addition, I wanted students to have a better understanding of the material and develop study skills and time management skills to help them succeed. In past semesters, data shows that students in Math1111 who attend Supplemental Instruction and Intervention Tutoring had better average final grades the more sessions that were attended. Each resource had a different impact on student grades based on a student's risk of failing. For this project, I continued to categorize my students as High, Moderate, or Low Risk of failing. I met with my High Risk students, and any student that indicated they wanted a tutor, to discuss their opportunities for tutoring and to gain a better understanding of my students. I promoted Supplemental Instruction and Intervention Tutoring throughout the semester and collected data to determine if these techniques help improve student success.

Purpose and Research Questions

The purpose of this project was to assess whether targeting High-Risk students, implementing Intervention Tutoring, and promoting Supplemental Instruction improved students' overall performance in Math1111 and Math1113. My Primary Research Question was: *What effect does intervention and promoting on-campus resources have in increasing student performance in core Mathematics courses?*

Methodology

Supplemental Instruction (SI)

SI sessions for each class were held for 1 hour, twice a week. Sessions were not mandatory, but students were encouraged to attend. There were at least two SI leaders available for Math 1111 and Math1113 during the project, provided by the Center for Academic Success. A student received credit for attending a one-hour session only if they were present for 50 minutes. Sessions are walk-in and there is not a cap on attendance.

SI leaders were required to attend my classes and take my notes. When a student attended SI, they received additional help that coincided with my lecture. Based on the SI leader's instruction technique, this may have involved peer tutoring, working extra problems, or answering student questions. The lecture was not re-taught. Some SI leaders also created study guides to help students practice for the exams. SI leaders did not receive a copy of an exam until after all students had taken it.

Intervention Tutoring (IT)

Intervention Tutoring was offered to all students who were categorized as High-Risk, or any student that indicated they wanted a tutor for the class. Once a student signed up for Intervention Tutoring, they attended a session for 1 hour each week. Sessions had no more than 4 students and were led by a peer tutor. During each session, students could ask questions and receive one-on-one, or group help from the tutor. Students were required to adhere to an attendance policy if they signed up for Intervention Tutoring. Students could sign up for Intervention Tutoring at any point during the semester if they felt they had a need.

SI Leaders

SI leaders are students currently enrolled at the University. They were either hand-picked by me or chosen through the Center for Academic Success. In addition, SI leaders were employed through the Center for Academic Success and were required to attend training. SI leaders conducted their session based on how they saw fit and kept up with student attendance.

Intervention Tutors

Intervention Tutors were hand-picked by me or recommended through the Center for Academic Success. Intervention Tutors were required to submit weekly updates summarizing how each student did in each session. I asked my tutors to indicate how each student was progressing academically and the student's attitude toward the content, the class, or myself. Attendance was also recorded by the tutor and sent to me. There were enough tutors provided so that any student who wanted to participate in the program had the opportunity.

Participants

Math 1111 is a 3-credit core course. For this project, Math1111 student improvement was measured for Fall 2015 only. Math1113 student improvement was measured for Spring 2016 only. Math1113 is a 4-hour credit course that requires a prerequisite. These classes are comprised of mostly traditional students that are within their first two years of college. There were 176 Math1111 students measured, and 76 Math1113 students measured.

Data Collection Strategies

In this study, I relied on quantitative data sources to answer my research question. Quantitative data included students' final grade and the number of Tutoring/SI sessions attended.

Math1111

PreQuiz. Students were given a Pre-Quiz on the first day of class. The Pre-Quiz was simple algebraic questions of very low difficulty, and questions of moderate difficulty whose concept is taught in the first few weeks of classes. It also contained questions that asked if a student had taken this particular class before (if they had, how many times), and how long it had been since their last Math class, and if they felt they would need a tutor during the semester. The student answers on the Pre-Quiz allowed me to categorize each student as Low Risk, Moderate Risk, or High Risk of failing the class.

Students were then asked to email me to receive their Risk Category. Students who were Low or Moderate Risk were sent information that gave my recommendations on what they should be doing in the class to be successful. SI was promoted for these students, and they were encouraged to attend sessions regularly.

Students who were categorized as High-Risk were asked to come to my office so we could discuss their options. They were then asked to sign up for Intervention Tutoring.

Number of Tutoring/SI sessions attended. A student that signed up for Intervention Tutoring was required to attend the same session time each week for one hour. They received credit for attending only if they were in the session for 50 minutes of the full hour. Students had to adhere to an attendance policy if they were signed up for Intervention Tutoring. Students could attend SI as often or little as they wanted, and they were not required to sign up for the sessions. They had to be in attendance for 50 minutes of 1 hour to receive credit for attending.

Final grade. A student's final grade was calculated based on exam scores, quizzes, and a final exam. Quizzes were worth 20% of a student's grade, exams were worth 50%, and the final was worth 30%. The final exam also replaced the lowest test grade and students were never allowed to make up quizzes or an exam, regardless of the reason for missing.

Exams. Exams varied throughout each semester, but each exam contained 20-25 questions. Questions were a combination of multiple choice, short answer, and fill in the blank. The questions were similar to homework problems, and consisted of formulas, definitions, and terms. Partial credit was given to short answer questions.

Quizzes. Students used the online homework system MyMathLab to work homework (ungraded) and take their quizzes. There was one quiz for each section, and quizzes were due the night before an exam. I dropped four of the lowest quiz grades at the end of the semesters.

Final Exam. The Math1111 final exam consisted of 40 comprehensive multiple-choice questions. There was no partial credit given for the exam, and no curve was implemented.

Math1113

PreQuiz. Students were given a Pre-Quiz on the first day of class. The Pre-Quiz consisted of basic operations and content covered in Math1111. It also contained questions that asked if a student had taken this particular class before (if they had, how many times), and how long it had been since their last Math class, and if they felt they would need a tutor during the semester. Using the answers students gave on the Pre-Quiz allowed me to categorize each student as Low Risk, Moderate Risk, or High Risk of failing the class.

Students were asked to meet with me at different times based on their need. If a student was High Risk and Indicated they wanted a tutor, they were asked first to meet with me and sign up for Intervention Tutoring. The next group I asked to meet with me were High Risk students that indicated they did not want a tutor. Next were Moderate/Low Risk students that indicated they wanted a tutor. For the Low Risk students that indicated they did not want a tutor, I sent an email letting them know I did not see a need to meet, but to please notify me if they begin to struggle in the class. All students that met with me were asked if they would like to sign up for Intervention Tutoring.

Number of Tutoring/SI sessions attended. A student that signed up for Intervention Tutoring was required to attend the same session time each week for one hour. They received credit for attending only if they were in the session for 50 minutes of the full hour. Students had to adhere to an attendance policy. Students could attend SI as often or little as they wanted. They had to be in attendance for 50 minutes of 1 hour to receive credit for attending

Final grade. A student's final grade was calculated based on exam scores, quizzes, and a final exam. Quizzes were worth 10% of a student's grade, exams were worth 60%, and the final was worth 30%. The final exam also replaced the lowest test grade and students were never allowed to make up quizzes or an exam, regardless of the reason for missing.

Exams. Exams varied throughout each semester, but each exam contained 12-17 questions. Questions were mostly short answer and students were required to show their work. Some multiple-choice questions were added. The questions were similar to homework problems assigned in class.

Quizzes. Students used the online homework system MyMathLab to work homework (ungraded) and take their quizzes.

Final Exam. The Math1113 final exam consisted of 36 comprehensive multiple-choice questions. There was no partial credit given for the exam, and no curve was implemented.

Results

To determine if implementing these techniques improved student success, I compared final course averages of students that attended SI/Tutoring to their average final grades for each risk category. Data was not collected on students who failed to take the final exam or did not give consent to use their scores. There were 176 Math1111 students and 76 Math1113 students analyzed.

Math1111

Table 1 shows the distribution of number of SI/Tutoring sessions attended, number of students attending, and average final grade for all students.

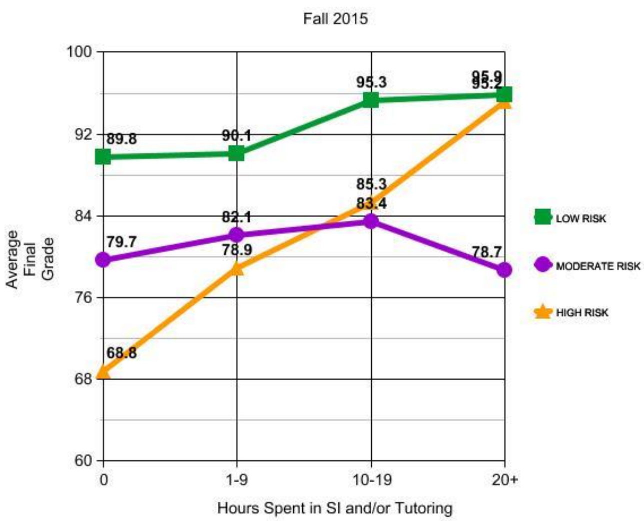
Table 1.

Sessions attended	**Low Risk**		**Moderate Risk**		**High Risk**	
	N	Average Grade	N	Average Grade	N	Average Grade
20+	2	95.9%	4	78.7%	1	95.2%

10-19	2	95.3%	9	83.4%	17	85.3%
1-9	19	90.1%	30	82.1%	15	78.9%
0	31	89.8%	37	79.7%	6	68.8%

Graph 1 illustrates the results

Graph 1.



Math1113

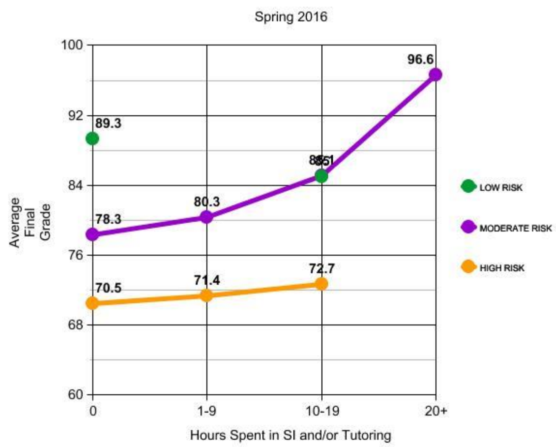
Table 2 shows the distribution of number of SI/Tutoring sessions attended, number of students attending, and average final grade for all students.

Table 2.

Sessions attended	**Low Risk**		**Moderate Risk**		**High Risk**	
	N	Average Grade	N	Average Grade	N	Average Grade
20+	NA	NA	1	96.6%	NA	NA
10-19	2	85.0%	6	85.1%	3	72.7%
1-9	NA	NA	9	80.3%	16	71.4%
0	16	89.3%	14	78.3%	9	70.5%

Graph 2 illustrates the results.

Graph 2.



Conclusion

Math1111. After analyzing the data, it is clear that implementing these techniques significantly improved student grades. High Risk students showed the most improvement when attending Intervention Tutoring and Supplemental Instruction. Moderate Risk students showed an increase until 20 sessions were attended and then a drop occurred. This drop could be due to the small number of data points for this category, or a student could have been incorrectly categorized. Low Risk students show that most do not attend tutoring, likely because they do not need it.

Math1113

Very few Low Risk students in Math1113 attended sessions likely because they did not need to. Moderate Risk students show the most improvement with average final grades the more sessions that are attended, and this appears to be a good model for Moderate Risk students. These techniques do not seem to help High Risk students significantly improve their average final grades. This could be due to a variety of factors, including difficulty of the material presented and the structure of the Intervention Tutoring sessions. I've listed a few ideas to improve Intervention Tutoring below:

1) Based on feedback from my tutor and students, a group of 4 students is too much for Math1113. This should be reduced to 2-3 students for each session.
2) Because the content is more difficult, most students will need to practice reviewing the content more often than they had to in Math1111. I suggest using an online homework system so the teacher can track how often a student works on homework outside of class. Math1113 is a 4-hour class, and I believe we could adjust the structure of the class and change one lecture hour to 1-2 lab hours where students work on homework. This is similar to the Emporium model that is currently being considered for Math1111 at the University. I believe this class would benefit more from that type of model, only if lecture hours remain at 3/week.

3) An Intervention Tutor should not hold more than 4 sessions each week. The tutors that worked more hours had more difficulty working with the students. Since these students are primarily High Risk, they may require additional patience from the tutor. A tutor holding 4 sessions a week.

APPENDIX L

SEEP - SPRING 2018 PROGRESS REPORT
INTERVENTION TUTORING
CARRIE CARMACK

Intervention Tutoring was implemented in Math1113 for Spring 2018.

In previous semesters, Intervention Tutoring did not appear to be impactful for Math1113. This is due to low engagement in the program. When the instructor invited the students to schedule a student-teacher meeting, very few students did so. It is during this meeting that the instructor discusses the Intervention Tutoring program and signs students up for the weekly sessions. However, the tutoring program did appear to be helpful for the students that did sign up. After reflecting upon this issue, it was decided that rather than remove the program in Math1113, it would be better to combat the issue of students not scheduling the one-on-one student teacher meeting.

For Spring 2018, Mrs. Carmack made the student-teacher meetings mandatory for students. Students are to meet with Mrs. Carmack twice during the semester, once at the beginning of the semester, and one more time toward the end. These meetings contribute to 3% of the students' final grade. As a result, of the 66 currently enrolled students, only 3 did not schedule a student-teacher meeting. During their first meeting (which occurred within the first 4 weeks of classes), the Intervention Program was discussed, and students were given the opportunity to sign up.

Progress - Results

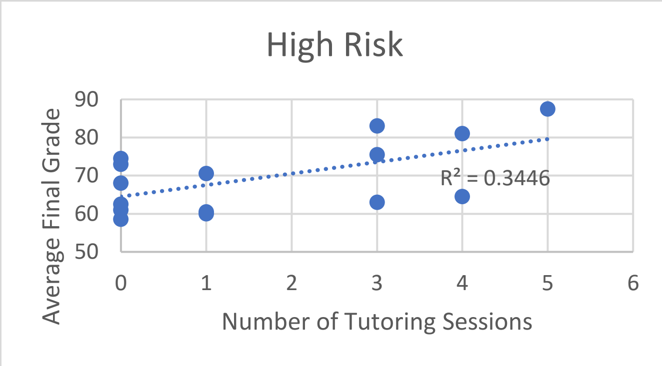
Six students were removed from the analysis. This was either because they did not take the risk assessment to determine their risk, or they have been absent for a significant number of lectures.

From the remaining 60 students, below is the number of high risk, moderate risk, and low risk.

Risk	Number of students
High	15
Moderate	31
Low	14

High Risk Students

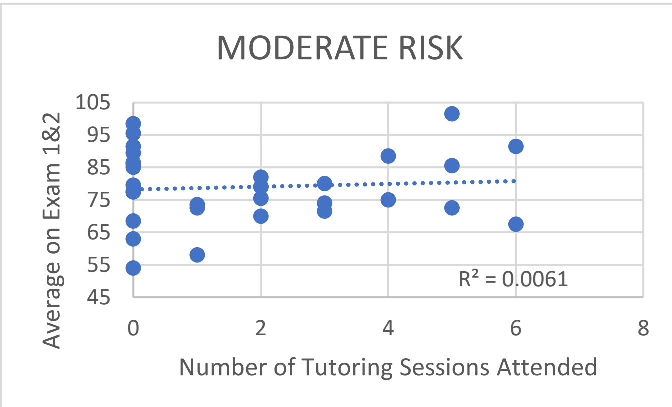
Of the high risk students, 9 out of 15 (60%) are in the tutoring program. The graph below illustrates the number of tutoring sessions attended and the average of Exam 1 and Exam 2.



High risk students show the biggest improvement when attending Intervention Tutoring regularly.

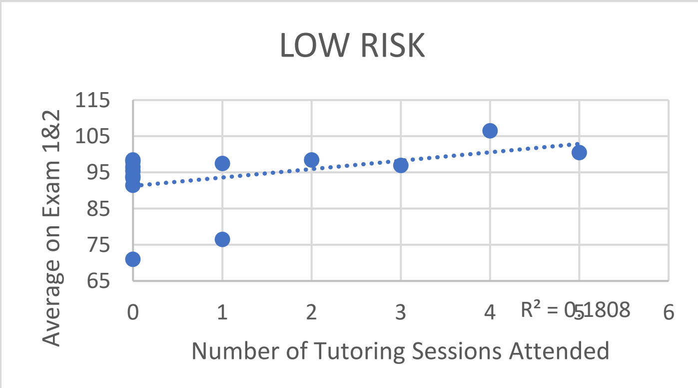
Moderate Risk Students

Of the moderate risk students, 18 out of 31 (58%) are in the tutoring program. The graph below illustrates the number of tutoring sessions attended and the average of Exam 1 and Exam 2.



There is still an overall improvement in average grades when the number of sessions increases, although not as significant as the high risk students.

Low Risk Students



Of the 14 low risk students, 6 (42.9%) are in the tutoring program. The graph below illustrates the number of tutoring sessions attended and the average of Exam 1 and Exam 2.Low Risk students also show an improvement in grades when attending Intervention Tutoring.

Conclusion

- Of the 60 students, 55% of them are signed up for Intervention Tutoring.
- 13 out of 60 (21.7%) students currently have an average of Exam 1 and Exam 2 that is lower than 70%. 7 of these students are not in the Tutoring Program. 3 of these students have recently signed up and have only been to 1 session, therefore, we are hopeful their grades will improve. The remaining 3 are participating in the tutoring program regularly, and their averages range from a 63% - 68%, so we are hopeful they can improve their test averages.
- There were 6 students that wanted to sign up for the Intervention Tutoring program, but the scheduled session times would not work for their schedule. We attempted to add a few more tutoring sessions during times that would allow for these students to attend, but we could not find tutors available during those times.

Note: we want to change the name of Intervention Tutoring. We feel the name implies that the student is currently doing poorly, and we want to "intervene", which we believe does not fit well with a growth mindset. We suggest something along the lines of <u>Peer Led Tutoring Lab</u>.