THESIS

SUPPORTING AND EMPOWERING STUDENTS IN ONLINE PRE-CALUCULUS

Submitted by

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ABSTRACT

SUPPORTING AND EMPOWERING STUDENTS IN ONLINE PRE-CALUCULUS

The Paced Algebra to Calculus *e*lectronically Program (PAC*e*) offers pre-calculus through five 1-credit courses in a fully online and mastery-based setting. The mathematics department at Colorado State University realized that a significant population of students were not completing the first module in the sequence. To address this issue, we created an in-person, supplemental course for a targeted population of students to complete the first 1-credit pre-calculus course. Using data from the students' weekly metacognitive and mindful journaling, we use the emergent perspective as our theoretical lens and thematic analysis as our tool for data analysis to answer the following research question: how did participation in an in-person class and engagement with the PACe Program impact the students' mathematical affect and success in the course? In this paper, we will examine previous results in the literature, define our research methodology, analyze implications on teaching, share key results and findings, and discuss future research questions that could be answered with our data.

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To begin, I would like to thank Jess for her unfaltering support. She has worn so many hats for me: a research mentor, a department advocate, a professional resource and collaborator, a teaching mentor, a critical editor, a walking confidant, a cool mom, and a personal friend. A million thank yous and Costco runs would not do justice to how grateful I am.

My gratitude extends to the math department, specifically to my fellow graduate students at (or previously at) CSU. Their support ranged from helping me with copious amounts of formatting and organizing to making sure I had eaten dinner. The graduate students, no matter the year, have taken their time to make sure I feel welcomed and included, and I cannot fathom success without their presence.

To my family, friends, and old professors and teachers, I thank you for your support. Each one of you had an impact on my life that has made me who I am today. Specifically, I would like to thank my parents, my sister, Olive, and Brian.

DEDICATION

I would like to dedicate this thesis to John and Anneliese Tisdale.

TABLE OF CONTENTS

Chapter 1

Introduction

1.1 Background

Some people believe that learning mathematics can be analogous to climbing a ladder; if you are missing key steps, you'll be incapable of reaching the end. Imagine, for example, that you are enrolled in a pre-calculus class. When the instructor introduces a new topic, you struggle to comprehend what is happening. Unlike subjects where the topics of instruction change daily, mathematics continues to build off previously taught foundations. So, as you enter class the next day, and each subsequent day after that, you're constantly trying to catch up as the instructor continues to move at a pace set by their own timeline and not the one most conducive for your learning. At Colorado State University (CSU), the mathematics department became aware of this limitation; that is, it can be next to impossible to teach a diverse population of students at a speed and with the depth necessary to foster universal student success. Thus, the department created what is now known as the PAC*e*, or the Paced Algebra to Calculus *e*lectronically, Program. When what is now PAC*e* was originally created in about 1975, it looked drastically different than it does today. There have been three evolutions of this program: The Math Module System, the Individualized Math Program, and the PAC*e* Program. At the beginning, faculty in the mathematics department were intrigued by the concept of mastery-based learning, so they created a self-paced curriculum custom to CSU and called it the Math Module System. It consisted primarily of tables with TVs and VCRs for students to use to watch pre-recorded content. As technology advanced and they transitioned into the Individualized Math Program, computers and feedback terminals allowed staff members to store information and students to see which problems they answered incorrectly. In 2005, the Individualized Math Program transitioned to the completely online PAC*e* system, and is the system we use to this day.

While the program underwent significant changes throughout these evolutions, there were many components that stayed the same. The pedagogical philosophy of the program being mastery-based has been preserved through each evolution, as well as a desire to serve students coming from diverse mathematical backgrounds. In each of these evolutions, there was some attempt at incorporating a "live" lecture. However, there were many problems with these lectures that kept reappearing in each evolution, so they stopped offering them in the early 2000s. Since then, PAC*e* has been offered completely online, with no in-person instructional component

PAC*e* is an online pre-calculus system with video lectures as the principal form of instruction, accompanied by PDF lecture notes. Rather than a single semester-long pre-calculus course, the pre-calculus content was modularized into five one-credit courses, each of which focuses on a specific pre-calculus topic. These courses are mastery-based, meaning that any component of the course may be redone as many times as needed to pass, where the passing score is 80% or above. No matter how many courses you are registered for, everyone must first complete the User's Exam, which quizzes students on various rules and procedures about the system. Within a course, there are a series of tasks you must complete to unlock remaining content. The Skills Review Exam is the first content-oriented exam that students must complete; it consists of ten prerequisite topics that students must show proficiency in. After completing this, students receive access to the first of four units of information. Each unit consists of 15 Required Assignments (3 questions per section, 5 sections per unit), a 10 question Review Exam (taken in any setting), and a 10 question Unit Exam (taken in a proctored setting). In order to unlock the n^{th} Review Exam, a student must both complete all Required Assignments in the n^{th} unit as well as complete the $n - 1^{th}$ unit's Unit Exam. Review Exams are graded based on completion (3 points if passed by the day it's due, 0 if not), whereas the proctored Unit Exams are graded based on the score you receive (8, 9, or 10). The caveat to the mastery-based idea is that every two times a student does not pass a Unit Exam, they must go back and repass that unit's Review Exam. After completing all four units, the course culminates in a 20 question Final Exam, which students must earn a 16 or higher on to pass. For more detailed information, refer to the PAC*e* Student Guide in the Appendix.

Although the intention of the program was to create a personalized mathematics experience designed for student success, there still exists a significant population of students who are not well-served by this program. From Rebecca Richard's perspective as an undergraduate mathematics advisor, Dr. Jess Hagman's perspective as a mathematics education researcher, and my perspective as previous Assistant Director of the PAC*e* Program, we conjecture that these students feel that they are not being served in an online mathematics environment, and need resources such as a structure, routine, and the physical presence of an instructor of an in-person class to have any chance of being successful. The lack of support, connection, and communication can make the PAC*e* program extremely isolating. This isolation creates barriers for struggling students to reach out for help, which ultimately leads to a cycle of learned helplessness that culminates with the termination of the semester and a grade of "Unsatisfactory." The consequence of receiving this grade reinforces their anxieties about math, their conflation of mathematics performance and worth, and their incorrect perception that they cannot be successful. This led to the inception of MATH 117 (College Algebra in Context I) Section 002, which was an in-person agency-based class made to support students through the PAC*e* content, and the focal point of this research and this paper.

1.2 Research Goals

This thesis focuses on an in-person section of MATH 117, or College Algebra in Context I, which ran during the Fall 2019 semester. We recruited students in science, technology, engineering, and mathematics degrees (STEM-intending) from marginalized identities flagged with high mathematics anxiety to participate to see how a community-based setting would impact their experience with mathematics. The goals of the research are to explore how

- participation in an in-person class, and
- engagement in the PAC*e* Program

impacted their

- mathematical affect, and

- success in MATH 117.

1.3 Positionality Statement

It would be unrealistic to assume I could remain impartial in this research; my experiences in mathematics have shaped both my self-confidence and my viewpoint on how equitible the subject is. To me, mathematics is an area that is intertwined with privileges for the white cisgender male. As a white cisgender female, it is clear to me that I can personally relate to my students who are within a minority based on their sex, but I cannot personally relate to students who have been discriminated against based on other attributes, such as their race. Identifying as a female, I have felt the pressures of imposter syndrome, tokenism, and stereotype threat throughout my mathematical career. I distinctly remember the first time I felt like an imposter mathematically: my Calculus I professor asked me to do research with him over the summer. Elated by both the project and the offer, I felt confident going to meet with him. However, my mother's comments to "be careful" and to "consider what I was wearing" activated my stereotype threat and made me question my worthiness to be given an opportunity. I later withdrew from this opportunity due to not feeling competent nor capable enough to meet my professor's expectations, which in reality were conflated with anxiety about being good enough.

After having this experience, I continued to have countless others that made me feel like an inadequate mathematician on the sole premise of being female: being the only female to participate in countless seminars, being told I only won an award for my research "because I was a girl", being ignored in meetings about teaching and being belittled for asking questions about content, being asked to "wash the dishes" in a room full of male mathematicians, being told that it would be very difficult, if not "impossible" to succeed; these microaggressions led me to not feel competent to be a mathematician. Without the support from professors and friends, I would not have been able to succeed and be where I am today. With these experiences, I am more aware of how I can potentially support the students in MATH 117-002 with their anxieties and identities, as well as

where I am currently unequipped, and therefore need to do work towards, being the best support for them.

During the Spring, Summer, and Fall semesters of 2019, I received an opportunity to work as the Assistant (and Summer) Director of the PAC*e* center. This position has given me invaluable insight regarding the ins and outs of the program, as well as the opportunity to interact with the students that take PAC*e* math classes. My responsibilities as a director consisted of engaging with students on a case by case basis. During this period of time, I saw a disproportionate amount of students who expressed negative feelings about the PAC*e* program. For a small population of students, the fault fell on their lack of engagement. The vast majority, however, were students who needed accommodations based on situations related to their personal life or disability. This caused me to question how many students were struggling with these issues who either did not know they could talk to me or did not feel PAC*e* or the CSU mathematics department provided them with a space to advocate for a more equitable educational plan. This experience continues to push me to create simultaneously professional and personal relationships with my students to build a mutual trust, so that they can have agency in their own education.

Chapter 2

Literature Review

In the research, the goal is to understand how a student's interaction with both the online PAC*e* system and our supplemental in-person course influences both their mathematical affect as well as their ability to succeed in MATH 117. In this section, we will highlight important literature about both online and supplemental instruction, define what exactly mathematical affect embodies, and go into a deep review of math anxiety, a heavily researched component of mathematical affect.

2.1 Online Instruction

While the online delivery of PAC*e* works well for some students, online delivery in general has been identified to negatively impact some students more than others. One primary advantage to the online system is that students are able to access course materials at virtually any time they desire. Additional advantages to online systems include formative and timely feedback, easier accessibility to large and diverse populations of students, and the ability for students to move through the material at a speed that best supports them (Engelbrecht and Harding, 2005). Online mathematics programs have great potential for success both at a local level by achieving satisfactory levels for their students' math performances and at a global level by meeting the university's core curriculum or other organization's requirements. However, it takes an immense amount of time and effort to continuously improve an online program so that it best supports a constantly changing population of students and meets the expectations of what should be taught. While online systems have some advantages, Hopper (2001) states that "internet teaching is so different from any of the categories of distance learning that preceded it that it is essentially a practice without research foundation (p. 253)." Stiles (2000) discusses some of the challenges of online learning, including failure to engage the learner, confusing interactivity with engagement, focusing on content rather than outcomes, mirroring traditional didactic approaches with the technology, and the failure to recognize and accommodate the social nature of learning.

We will explore two of these problems further: the lack of communication and the lack of engagement. In regards to communication, Engelbrecht and Harding (2005) discuss the importance of synchronous (same time) and asynchronous (any time) communication. Examples of synchronous communication online include tools like video calls, shared whiteboards and presentation tools, screen sharing tools, and chat rooms, while examples of asynchronous communication online include e-mails, discussion forums, and surveys. Both types of communication need to be supported and fostered; Swan et al. (2000) puts the responsibility on the instructor to guide students' participation through the interface and facilitate these online communities. However, when the instructor for the course is next to anonymous, this responsibility is shifted to the students, which significantly impacts their ability to be successful.

While communication between students is difficult in any online setting, the interface itself can create such strife that any interaction can seem fruitless. Engelbrecht and Harding (2005) assert that the "...online mathematics course must be the teacher, the mentor, the facilitator, the comforter, and the threat. The course must do many things that mimic human interaction. To the student it must converse, engage, entertain, encourage, challenge, and sympathize (p. 257)." The online system must be able to not only address, but actively and appropriately take on, each of the roles found in a traditional classroom. Additionally, it addresses the issue that online mathematics programs may just encourage a student to utilize quick tricks and random formulas versus understand the conceptual reasoning behind their steps. In fact, some students may not even be able to work with the course interface, where inconsistencies in, for example, the inputs of answers, can easily lead to frustration. It is an incorrect assumption that all students participating in these courses are able to cope with self-directed learning. Engelbrecht and Harding conclude that without the proper support and connection, students will easily become frustrated when they encounter difficulties and thus the completion rates for poorly developed programs are often low.

2.2 Supplemental Instruction

The purpose of supplemental instruction (SI) is not to replace the original instruction; it is to provide an additional space and resources to foster student learning. Malm, Bryngfors, and Mörner (2011) claim that the main idea behind supplemental instruction is that the student's learning is enhanced through a collaborative and community-based setting. Additionally, fundamental features of supplemental instruction include optional instruction and instruction that is driven by the student's wants and needs, with the focus shifted from high risk students to high risk courses (Harding, Engelbrecht, Verwey, 2011). This shift in focus stems from the difficulty of identifying exactly who is a part of this population; more often than not students are identified for correctional instruction only after they receive a grade for their first exam (Arendale, 1993). The instructional team for supplemental instruction typically consists of the SI coordinator and SI leaders. The SI coordinator is in charge of arranging activities to be done in the supplemental instruction and guiding the SI leaders, who are responsible for conducting the SI sessions. It is quite common that the SI leaders are senior undergraduate students who have successfully completed the course in the past (Harding, Engelbrecht, Verwey, 2011).

Since students can opt to participate in supplemental instruction, there are not many disadvantages to this instructional strategy. The research behind the advantages though is extensive; studies show that participating students improve their grades and reduce the number of failed exams (Malm, Bryngfors, and Mörner, 2011). For example, Arendale (2001) divided students into three groups depending on their college entrance exam scores: "weak", "average", and "strong." He found that SI attendees from all three groups experienced significantly better final course grades than their peers. This one example highlights just how impactful supplemental instruction can be for students' success in a course; our goal is to create an SI-type environment that not only benefits the students in their success in MATH 117, but also influences them in changing their mathematical affect in a positive way. One key difference in our implementation of the SI-like support is that the extra instruction was offered as an option for a specific population of students to opt in to that

would then affect a portion of their grade. In this way, our approach deviates from the traditional SI approach, but in all other ways the course functions as an SI.

2.3 Mathematical Affect

It can be difficult as an educator to understand why a student who has shown they are mathematically capable does not succeed. When we focus solely on mathematical competence, we deemphasize other facets and characteristics of students as whole humans that exist outside of mathematical performance. Studying the student's mathematical affect allows us to attend to these attributes, and thus plays a key role in understanding the student's performance. Yackel and Rasmussen (2002) conclude "...that attention to student beliefs is not a logical necessity but proves pragmatically useful because it helps to account for aspects of students' mathematical activity that otherwise are not explainable (pg. 314)."

Loosely, affect can be defined as a student's beliefs or feelings. However, there is a much deeper analysis of the physiological and psychological components of affect. Goldin (2002) discusses the various functions of the body's affective system, and asserts that this system is not just a sub-branch of cognition. He asserts that affect encodes information in various contexts, such as information about the environment (feelings of fear encoding danger), the individual (feeling of loneliness encoding absence of intimacy), and others (feelings of pride encoding satisfaction). There is even an "affect about affect", referred to by Goldin as meta-affect. We can further analyze each of these domains. For example, within the individual domain, there exist four subdomains: (1) emotions, (2) attitudes, (3) beliefs, and (4) values, ethics, and morals (DeBellis and Goldin, 1997). In our study, we care about the individual domain of affect (and thus the four subdomains) with an emphasis on their mathematical affect. While we do study the environment and their peers, we focus on the influence of these factors on the individual's mathematical affect.

There are constructs of an individual's affect that are important to engaging in mathematics, which include mathematical intimacy, mathematical integrity, and mathematical self-identity (Vinner, 1997; Goldin 2002). The first construct, mathematical intimacy, measures how much the in-

dividual actually cares about mathematics; for example, a student can be very talented in algebra, but lack the personal investment to do homework assignments or example problems. The construct of mathematical integrity encompasses an ability to acknowledge a lack of mathematical understanding, which is an extremely difficult concept to acknowledge in any context. The last construct combines the mathematical cognition and affect to answer the question "Who am I?" in the context of mathematical identity and sense of belonging (Goldin, 2002). In the next section, we discuss in further detail math anxiety, an individual emotional construct of mathematical affect.

2.4 Math Anxiety

While many people have anxiety in a general school setting, mathematics fosters a unique anxiety with its conflation with intelligence. Gutiérrez (2018) highlights this misattribution, stating:

> ...so many people are walking around in society who have experienced trauma, microaggressions from participating in math classrooms where the idea of being a successful..., intelligent person is removing oneself from the context, not involving emotions, not involving the body, and being judged by whether one can reason abstractly. (p. 18)

This immense pressure can cause trepidation for an individual, affecting participation in a mathematical context, and leading to math anxiety. Ashcraft defines math anxiety as a "feeling of tension, apprehension, or fear that interferes with math performance" (2002, p. 181). The key piece of this definition is that the anxiety interferes with math performance, or actively causes students to have to work harder to achieve similar results as their peers who do not experience math anxiety. Individuals with math anxiety are characterized by a strong tendency to avoid mathematics, which can have drastic effects on their mathematical competence and ultimately their future careers, as well as espousing "negative attitudes toward math, and hold[ing] negative self-perceptions about their math abilities (pp. 181-182)." It is also extremely common that students couple their math anxiety with other anxieties, with the highest correlation being test-taking anxiety.

Preis and Biggs (2001) describe math anxiety as a cycle, as shown in Figure 2.1 (reproduced here for convenience). To understand this cycle, consider an example student who has a negative feeling toward mathematical related situations due to a traumatic experience the student has had with mathematics in the past. The cycle then continues into the general avoidance of mathematical situations; the body's natural desire to avoid situations which make us anxious is hardwired into our brain's "flight or fight" response. Because the student is avoiding mathematical situations, they are less prepared mathematically, and thus exhibit poor mathematical performance. The cycle begins again by this poor mathematical performance acting as the trauma that causes the student to continue to have negative feelings toward mathematics and negative perceptions of their own math abilities.

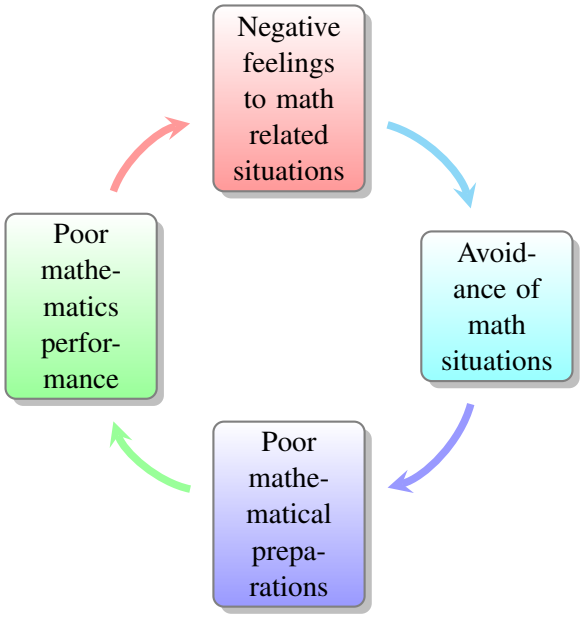

Figure 2.1: The cycle of math anxiety. From Pries and Briggs, 2001.

In Ashcraft's work, they explored some of the effects of math anxiety on mathematical performance. In this study, they had individuals complete a series of whole-number arithmetic problems. One problem they put forth for the students to solve was based on Dehaene's (1997) concept of number sense, or the ability to use the context of the problem to see if one's response "makes sense". For example, it would be implausible for the length of a football field to be -11 meters

long. They found that individuals who identified as highly math-anxious made more errors as the problems became increasingly impractical (e.g. True or False: 4+3=39) compared to students who identified as having low math anxiety. Another variable Ashcraft and this research team explored was the time that it takes these individuals to complete certain tasks. They observed that for problems such as 15+16, which require carrying a one to the tens place, participants with high anxiety took three times longer to complete the problem when compared to participants with low anxiety. It is worth noting that, during the True/False problems, highly anxious participants responded up to as rapidly as those without or little math anxiety; in other words, students with higher math anxiety sped through the exam to reduce the amount of time in which they needed to be answering math questions. This behavior exemplifies a reversed effect with similar motivation: the global avoidance of math at the local level.

The anxiety that the participants experienced in Ashcraft's experiment greatly impacted their performance in a way that reflects how a student with math anxiety would struggle to perform in a math classroom. One possible explanation as to why the anxiety affects their performance can be found in Calvo and Eysenck's (1992) processing efficiency theory. This theory proposes that anxiety acts like a secondary task, and that these individuals with high math anxiety must dedicate attention to their intrusive thoughts as well as the mathematics. So, for example, when students are taking a timed mathematics exam, students who experience math anxiety are at a disadvantage since part of their time is dedicated to coping with anxious thoughts that are outside of their control, instead of being able to exert maximal mental energy on the math exam.

Preis and Biggs assert that an individual's inception of math anxiety begins with some sort of negative mathematics experience. Jackson and Leffingwell (1999) built upon this work by looking more closely at the beginning of math anxiety for many students, classifying these experiences by grade clusters, and specifically focusing on the role of the instructor in causing these anxieties. Their research had respondents answer the following question: "Describe your worst or most challenging mathematics classroom experience from kindergarten through college." The three main clusters of responses came from the elementary level (especially grades 3-4), the high school level

(especially grades 9-11), and the college level (especially freshman year), with fourth grade being the most prevalent grade where students first experience math anxiety. Some of the reasons that the respondents listed are the difficulty and quality of instruction, insensitive and uncaring nature of the instructor, and bias over various factors like gender and age. Jackson and Leffingwell then listed some overt and covert behaviors that an instructor could have, such as verbal statements and body language respectively, that a student might internalize and, in doing so, be impacted negatively. They also discussed the active role an instructor can take in reducing anxiety and facilitating enjoyment, such as disclosing personal struggles and strategies, offering additional resources to struggling students, and making a conducive environment that ensures mutual respect. Being cognizant of one's role in both causing and reducing anxiety is a step towards creating a healthy, productive classroom for all students, not just those who don't suffer from math anxiety.

Given this information, our objective as an instructional team was to create an environment that supports a population of students with high mathematics anxiety for whom an online setting may not optimally serve. Regardless of where the student developed the anxiety, our goals remained the same; to create an environment where our students could succeed. With this goal and the aforementioned data in mind, we created the in-person supplemental component of MATH 117. We will discuss the details of the study in greater depth in the following sections, and will first highlight how our research perspective allowed us to be aware of the challenges faced by our target population of students.

Chapter 3

Research Methodology

3.1 Research Perspective

Collaborative, community-engaged scholarship (CCES) and community-based participatory research (CBPR) were the two guiding methodologies we implemented in our class. While CCES has been historically referred to as participatory action research, or PAR, the shift towards including the word community allowed us to attend to issues of equity and social justice as we created and launched this course. Warren et al. (2018) describes CCES as a "collaborative enterprise between academic researchers and community members... We do not mean advocating *for* communities. Rather, we mean working *with* communities to advocate for change (p. 446)." They highlight in their work that CCES can be more rigorous than traditional research approaches, because it necessitates asking questions that previously may not have been considered; if you are not asking the community how they want to be supported, you may never think about that perspective.

Implementing practices based on this work has benefits for both students and instructors. Our students are taking a risk by signing up for an experimental course; there is a potential that they might be better served in the online environment. By allowing the students to participate in how the course is run, we allow them to achieve agency in the classroom; moreover, they are able to communicate directly with us regarding how we can best support them, as they themselves are the experts on what tools and strategies serve them best. On the instructor side, this was a brand new experience for our whole teaching team, so having detailed formative assessments allowed us to modify and improve our instructional design. However, the only way for everyone to benefit from this action-based research strategy would be for all of us to be in constant communication. This was accomplished through (a) weekly journaling, (b) the creation of an instructional team that included one student who was part of the community we were working to better support, and (c) restructuring the course based on conversations with the students.

3.1.1 Reflective Journals

Waldlock et al. describes the importance of journaling to be the development of students' planning and reflective skills (2001). We wanted to make sure that our students were participating in metacognitive and mindful journaling in order to see their thought processes and increase their self-awareness of their mathematical tendencies. Schneider and Artelt define metacognition as a term that "...refers to people's knowledge of their own information-processing skills, as well as knowledge about the nature of cognitive tasks, and of strategies for coping with such tasks (2010, p. 149)." In more specific terms, Flavell describes one of the three facets of metacognition to be metacognitive experiences, which refer to the feelings and awareness surrounding a situation that requires problem-solving (1979). To ensure students participated in a metacognitive manner, each journal prompt was carefully crafted to elicit these sentiments. We used key words and phrases, such as asking students to reflect on their experiences, describe factors in hypothetical scenarios, identify specific moments as successes and struggles, and compare and contrast their identities from before class to now; each of these prompts was written to encourage our students to think and process each question, and to write down and communicate meaningful responses.

When asking students to journal, there can be a looming anxiety about writing perfectly and a judgement surrounding the artistry of each sentence. We aimed to reduce this anxiety by fostering a safe environment for students to communicate their thoughts. Intentionally reducing this anxiety was also beneficial to us as researchers, as it provided an opportunity to see the raw, original thoughts of our students, in contrast to the meticulously edited and convoluted piece that may have been created by a student who feared academic judgement. In order to accomplish this reduction in anxiety, we promoted the concept of mindful journaling. Mindfulness is a module frequently utilized in Dialectical Behavioral Therapy (DBT), which Kabat-Zinn defines as "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally (1994, p. 4)." Its implementation involves two pillars: first, participants must understand what to do, and then understand how to do it. Dialectical Behavioral Therapy also incorporates three "what" skills: to observe, describe, and participate, and three "how" skills: to do so one-mindfully, non-judgmentally, and

effectively. To illustrate both what these skills were and how to implement them while journaling, we created a "Guide to Mindful Journaling" that was linked to every journal entry on Canvas (an online instructional tool). In it, we gave a brief description of each of the "how" and "what" skills, tips on how to remain mindful in each setting, and examples as to how it might look to be journal mindfully. See the Appendix for more details.

3.1.2 Instructional Team

The class was designated to meet on Tuesdays and Thursdays, led and assisted by various members of our teaching team. On Tuesdays, the course was led by Dr. Jess Hagman, with myself as a co-instructor. We were also assisted by three learning assistants (LAs): Marco, a mathematics education major, Mandie, a current PAC*e* student, and Tony, a PAC*e* Course Assistant. The people participating in the instructional team were intentionally chosen by Jess and myself to fill a unique role. In particular, the choice of Mandie was strategic for our adherence to the methodology outlined in CCES; having Mandie on the instructional team while she participated within the system as a member of the community we were trying to serve allowed us access to a perspective the rest of us may have overlooked or missed altogether. For example, the experience of getting a seven on a proctored exam (one point away from passing) and needing to go back and repass the review exam before you can take the proctored exam again *sounds* frustrating, but only Mandie *knows* how frustrating that can be. Thus, Mandie's purpose was twofold: she was able to describe in more detail some of the challenges our students might face, as well as empathize on a level with our students that we could not, given the power dynamic that exists within any classroom setting. In addition to Mandie, Jess and I volunteered to fill the roles of co-instructors due to our invested personal interest in supporting this population, as well as our knowledge of teaching strategies and PAC*e* procedures respectively. Marco was chosen due to his interest in teaching. Lastly, Tony was chosen due to his extensive expertise with the content; he often showed us how to help the students work "smarter, not harder," which was a key instructional strategy towards our goal of helping the students succeed in the PAC*e* system.

One important reason as to why we chose to have LA's is that Jess and I are both white women with multiple degrees in mathematics. Our student population was racially and ethnically diverse and specifically included students *not* pursuing math focused majors, primarily biology and psychology. Mandie, Marco, and Tony all identify as people of color, where Mandie and Tony were pursuing degrees in Biology, and Marco had recently switched from Psychology to Math Education. Additionally, Mandie and Marco were recommended to us because of their participation in a learning community for students of color in the College of Natural Science, and Tony was recommended since he brought robust knowledge from his experience as a Course Assistant. These people were an integral part of our instructional team and in the successes of our course.

In the next section, we will discuss the nature of our course, our ideas and instructional perspectives coming into the course, and how CCES created agency for our students to shape the nature of the course.

3.1.3 Responsive Course Structure

Our course met once a week during the Fall 2019 semester for 50 minutes on Tuesdays, with an additional 50 minute optional (but highly encouraged) review session on Thursdays. The course was designed so that 80% of students' grades would come from their PAC*e* performance and the other 20% of their grade would come from our class's journaling requirement. Each week, the students (who will be described in further detail in the Participants/Students Section) were assigned a journal prompt, which we would then read, compile, and use to shape how the next class was run.

As an instructional team, we met once a week to discuss classroom and tutoring hour observations, important content for the week, and the weekly journal responses. In this discussion, we highlighted problems that occured, problems we were anticipating, and collaborated on solutions. This communication led to the class having a responsive structure, meaning we adapted both our beliefs about how the course should be run and the actual way the course was run. Our original teaching goals were to support the students in their development of mathematical knowledge, their

change in mathematical affect, and their success in the course. However, we quickly realized that our implementation of these teaching goals did not align with the intention of the creation of the course; to serve the students, we needed to help them pass PAC*e*, which made us change the way we ran the course.

It is difficult to describe what a typical day in the class looked like, since the format of the class changed throughout the semester. However, there were some main phases that occurred. In the beginning of the semester, our initial plan was to spend time discussing the setup of the course, the intentions of why this course was created, and begin to delve into the students' mathematical confidence. We had students take an adapted version of the Abbreviated Math Anxiety Rating Scale (A-MARS; will discuss in detail in Data Collection), and after viewing those responses we decided to spend additional class time discussing test taking and time saving strategies. This took up the first two class periods, with our next shift being a focus on prerequisite mathematics to MATH 117.

The Entry Level Mathematics Tutorial (or ELM) is one way to satisfy the prerequisite for MATH 117. While our students had permission for this one semester to have access to the MATH 117 content without needing to complete the ELM, we still intended to find key concepts from the tutorial to review with our students. After sending out a survey to rate their confidence on different concepts on the ELM, we decided to spend the next two class periods working on factoring and adding and subtracting rational expressions. We split the students into three groups: one led by Dr. Hagman, one led by Mandie and myself, and the last led by Marco. During these two class periods, we realized that certain students were disengaged and that students were getting confused by our varying styles of how to solve a type of problem. While reading the journal articles for week three, Montana responded with the following:

> You're probably so used to me saying the same thing about math these past journals and honestly I am too. It's kind of exhausting writing these knowing someones going to read it and see how much I really just can't do math. Writing these journals actually make me sad. I hate being reminded of how I can't do these problems and I know I

> probably could if I tried tried tried, but I don't know why I can't even try. Everytime in class I still feel so left out in an academic stance. The people in my class know math, they understand concepts, patterns. I'm not the type to learn in a math group. I need a one on one type of basis to get me to understand this. You're probably thinking that if I want this so bad why don't I ask for it or why don't I even try. I hate having to try when I'm with my peers, I know there's probably no judgment but the judgement I have within myself, over powers it all. **There's just something about the class that isn't helpful to me at all, I get the concept and I think it's great but my classmates obviously are more ahead then I am and it really just makes me feel awful about myself.** They all have their strategies and their ways, but I don't and it's so irritating.

After reading this journal entry, we realized that there needed to be a major change in the way we ran the course. So, we spent the fifth class period allowing the students to choose which instructor they wanted to have a conversation with about their sentiments on the course. Many mentioned they were afraid they were behind their peers outside this class, they just wanted to start MATH 117, and that they wanted stations with different content and comfort levels. Starting the sixth week and continuing for the rest of the semester, we spent our in-person classes having them grouped based on what required assignment(s) they were working on, so they could work with their peers and ask us questions as needed. During the remaining weeks, our students began to break up into three main categories: we will call these populations A, B, and C, and will define them in the following section.

3.2 Participants/Students

Since completing math requirements is a necessary part of obtaining a STEM degree in a timely manner, our student recruitment was restricted to STEM majors. We also recruited students who had a "math flag" which identifies students who have math as their reason for being an admitted student with support; these reasons could stem from low test scores or high math anxiety. Additionally, we prioritized class space for students from historically marginalized identities because of

the disproportionate enrollment and success of these students within STEM fields, and because of the additional barriers these students face within STEM degrees, such as stereotype threat, implicit bias, and microaggressions. Advertisements for the course were sent out to the College of Natural Sciences (CNS) academic advisors, where it became their role to find advisees that matched our criteria.

While we started out with 27 students, 24 retained enrollment. We had all STEM intending students: 15 were Psychology or Neuroscience majors, 7 were Biological Science majors, 1 was a Zoology major, and 1 was a Computer Science major. Nineteen of our students identified as female. Penelope was in her third semester, while all other students were in their first semester at CSU. Further, Penelope, Olivia, and Montana were sophomores by credit while the rest of the students were first years.

We call the 11 students who passed the class population A, the 4 students who made it about halfway through the course population B, and the 9 students who made it up to the first unit exam population C. It is noteworthy that nobody in population A switched their major, while there were some students from both populations B and C that changed to something out of STEM. See the Tables 3.1, 3.2, and 3.3 below for more detailed information on all students, including their final point accumulation in PAC*e*- students could earn up to 72 points, and anything below 57 points is considered an Unsatisfactory. These three populations will be used to group students throughout the discussion of the results.

We focus on the general consensus across all populations from the data in the beginning of the semester, followed by analyzing how each of the populations changed or did not change their sentiments as the semester continued. While we have a strong data set for population A, students in populations B and C did not always participate at the same frequency in journaling, so the implications that can be made from this data may be weaker.

Table 3.1: Information about students in population A.

Pseudonym	Major	Race	Ethnicity	Sex	Age	Class	Semesters at CSU	SAT	ACT	GPA	Final PAC*e* Score
Ariel	Biological Science	American Indian or Alaskan Native	Hispanic or Latino	F	18	Freshman	1	490		2.692	60
Brendan	Computer Science	White		M	19	Freshman	1	500		2.866	62
Halle	Zoology	White		F	19	Freshman	1		22	3.524	65
Jessica	Psychology	White	Hispanic or Latino	F	18	Freshman	1	400		2.889	60
Luis	Biological Science	White	Hispanic or Latino	M	18	Freshman	1	450		3.077	63
McKenna	Psychology	White		F	18	Freshman	1	410		2.667	58
Montana	Psychology	Black or African American		F	19	Sophomore	1	400		3.25	64
Rhea	Psychology	White		F	18	Freshman	1	460		3.142	63
Orina	Psychology	White		F	19	Freshman	1	700		3.00	63
Sharna	Neuroscience	Black or African American		F	18	Freshman	1	360	16	2.091	64
Shelby	Psychology	White		F	18	Freshman	1	630	25	3.571	66

Table 3.2: Information about students in population B.

Pseudonym	Major	Race	Ethnicity	Sex	Age	Class	Semesters at CSU	SAT	ACT	GPA	Final PAC*e* Score
Emily	Biological Science	White		F	18	Freshman	1	590	17	2.642	22
Sasha	Psychology	Multiple		F	19	Freshman	1	430		1.846	20
Ty	Psychology	White	Hispanic or Latino	M	19	Freshman	1	430		0.533	31
Valerie	Psychology (switched to Human Development and Family Studies)	White		F	18	Freshman	1		22	3.182	23

Table 3.3: Information about students in population C.

Pseudonym	Major	Race	Ethnicity	Sex	Age	Class	Semesters at CSU	SAT	ACT	GPA	Final PAC*e* Score
Connie	Biological Science	White	Hispanic or Latino	F	19	Freshman	1	410		1.846	3
Jordan	Psychology	White		F	18	Freshman	1		18	1.636	3
Kylie	Biological Science (switched to English)	American Indian or Alaskan Native		F	18	Freshman	1		18	2.733	3
Merida	Psychology	White		F	18	Freshman	1	530	16	2.167	0
Olivia	Psychology	White	Hispanic or Latino	F	19	Sophomore	1	440		2.928	12
Penelope	Biological Science (switched to undeclared exploring)	White	Hispanic or Latino	F	20	Sophomore	3		15	1.666	3
Poppy	Psychology	Black or African American	Hispanic or Latino	F	18	Freshman	1	480		2.333	0
Simon	Psychology	Black or African American		M	18	Freshman	1	460		2.076	11
Trent	Biological Science (switched to English)	Black or African American	Hispanic or Latino		19	Freshman	1	560		0.769	0

3.3 Data Collection

The primary source of data analyzed for this paper is the journal entries that the students completed. Additional collected data includes classroom observations, attendance and progress results, and a survey about math anxiety (A-MARS); these additional data will be used for triangulation of findings from the reflective journals and to provide additional context.

3.3.1 Reflective Journals

Throughout the semester, students were asked to report on their progress and experiences in a weekly journal. Journaling served both as a medium for our students to communicate with us, and as the main form of data that we collected. In the beginning, students were required to write 400 or more words, but this policy was relaxed to 200 words by week 5 based on feedback gathered in the class conversation during week 5. Students were encouraged to reflect on their own process, their experience within our classroom community, and give us feedback on how we could better support them. While these assignments were a completion-based portion of their grade, not all students completed the assignment. The following gives the journal entry prompts for each journal, as well as how many respondents we received:

Journal Zero: (student responses = 26) What is your math story? As students, math is an integral and necessary part of schooling. What formative memories shaped your views of math today? Below are two questions to answer as you reflect on your experiences:

- Describe your best or most successful mathematics experience. What factors led to this being a positive experience?
- Describe your worst or most challenging mathematics experience. What factors could have made this a more positive experience?

Journal One: (student responses = 21) For this entry, you will need to visit the PAC*e* center, complete the following tasks, and reflect on the environments:

- Take a seat in the learning center and describe your experience. What aspects (if any) of the learning center made you feel at ease? What aspects (if any) of the learning center made you feel anxious?

- Take the user's exam in the testing center and describe your experience. What aspects (if any) of the testing center made you feel at ease? What aspects (if any) of the testing center made you feel anxious?

Journal Two: (student responses = 26) On a scale of 0 to 10 (with 0 being not at all to 10 being extremely) how math anxious are you? As you think about this question, fill out the [A-MARS]. Choose 2 to 3 of the questions on the form to reflect on for this journal entry.

Journal Three: (student responses = 21) Pick two problems from the ELM confidence survey that you rated as a yellow or red for confidence. Choose one strategy from the test taking strategies [see appendix] and either choose a different strategy from our list or one of your own. In this journal entry, be mindful as you describe how each of these strategies felt as you worked through the two problems. Be sure to let us know what problems and strategies you chose!

Journal Four: (student responses = 23) Given the problem "Factor $6x^2 + x - 12$", answer the following prompts:

1. Solve this problem.

2. What strateg(ies) did you use? Evaluate how productive (if at all) each strategy was.

3. How did you feel solving this specific problem?

4. How do you feel now about solving factoring problems in general? How has it changed from how you felt before?

Journal Five: (student responses = 23) This week, we just want to hear about you. Anything you're feeling or that's on your mind, please feel free to share with us.

Journal Six: (student responses = 24) Reflect on how the skills review exam felt. Some questions to spark your writing (but you do not have to answer) are: What did you struggle with? What did you succeed with? Did you work on it outside of class time? How does it feel to start PAC*e*?

Journal Seven: (student responses = 24) Reflect on how starting Unit 1 felt. Some questions to spark your writing (but you do not have to answer) are: How were the videos? Was the PAC*e* website easy to use? What required assignments did you have trouble with? What required assignments were a breeze? Did you utilize Tuesday or Thursday's class time to complete these assignments?

Journal Eight: (student responses = 14) This week, you must go to the PAC*e* learning center at least once and work on the required assignments for Unit 1 (if you've finished, you can work on the Review Exam or the Unit 2 required assignments). Introduce yourself to a course assistant and include their name in this entry. A great way to do this is to ask a question about the mathematics, but if you don't have a question they'd still love to say hello! The entry must include the following:

- How was your experience in the learning center?
- Who did you talk to in the learning center?
- How did the PAC*e* math material go this week?

Journal Nine: (student responses = 18) Reflect on your experience taking the Unit 1 Review Exam (RE) and/or the Unit 1 Exam (UE). Don't forget that in order to have access to the Unit 2 Review Exam (Due November 4th!) you have to have passed the Unit 1 Exam!

Journal Ten: (student responses = 17) Reflect on your math experience and your Journal 0 Entry. What changes have you noticed since you've been going through PAC*e*? Do you feel like your math identity has changed?

Journal Eleven: (student responses = 16) Discuss either or both of the following two points:

1. What are you struggling with in PAC*e*? For example, it could be a specific part of the content, time management, passing the proctored exams, etc. How do you think you can

help yourself and ask for help (from classmates, instructors, and/or course assistants) to become successful?

2. How are you succeeding in PAC*e*? For example, it could be a specific part of the content, time management, passing the proctored exams, etc. What actions do you attribute to your success, and what suggestions do you have for others to be successful?

Journal Twelve: (student responses = 14) What are your thoughts going into the PAC*e* final? How are you planning to support yourself as you prepare?

Journal Thirteen: (student responses = 9) This journal entry, we are extremely interested in your feedback, since it will help us continue to run this course for the future. Keep that in mind as you choose to answer these questions! Thank you all for being such amazing students! (:

Answer one (or more!) of the following questions:

- What have you learned this semester about PAC*e* that will help you succeed in PAC*e* in the future?
- If you could remodel PAC*e* (physically, for example more computers in the testing center, noise canceling headphones, etc), what would you suggest?
- What was your biggest challenge? What was your biggest success?
- Which unit was easiest for you and why? Which unit was hardest for you and why?
- If you were to take this course again, what would you recommend we continue? What should we change?

(Optional) Journal Fourteen: (student responses = 2) Feel free to use this space to let us know anything! Thank you so much for a great semester.

3.3.2 Class Observations and Student Progress

All members of the instructional team were also active observers; it was integral to implementing CCES that we were cognizant of the behaviors that were occuring in and out of our classroom.

These observations were discussed in our weekly meetings and helped us shape the course to respond to student feedback that was not explicitly given through the journaling of the week. From a research perspective, being an observer was an imperative method of increasing the accuracy of the journaling data. For example, occasionally students stated that they were engaging with the course material. However, the lack of student attendance and progress in the course proved to us that, while this may have been something they *wanted* to do, this was not something they were *actually* doing.

In addition to observing their behavior, we also kept detailed records of students' progress. Since we had access to their PAC*e* accounts, we would share in our meetings how far along our students were in a specific unit. This was helpful in planning class activities; for example, if a majority of our students were on Unit 3, we would want to plan group work and review teaching strategies primarily focused on Unit 3 content. The frequency of how often we checked their progress depended on the urgency of a deadline; at times we checked their progress twice a week, but sometimes we checked their progress at multiple points throughout the day when the students were approaching a major deadline. This quantitative data helped us see trends regarding when populations B and C stopped engaging, and where all populations encountered difficulties and successes.

3.3.3 A-MARS Survey

The Adapted Math Anxiety Rating Scale (A-MARS) instructs the participant to "please indicate the level of your anxiety in the following questions:" and then asks them to rate 25 different scenarios using a 5-point Likert scale ranging from "not at all" to "very much." At this point, we had 27 students enrolled in our class, but we received between 27-28 responses for each question, leading us to believe that a student accidentally took the questionnaire twice, and leading to the number of responses to vary by question. We gave the students this survey in class on week two, and discussed with them some of the results on week three. In the Results and Discussion section, we choose a few interesting cases to analyze to triangulate our data, and in the Appendix the reader

can find the full results. One thing to note is that since the instructional team converted the original scale over to a google form there are two typos which were understood by our students: one is "a fair amound" instead of "a fair amount" as one of the 5-point scale ratings, and the other is the word "being" instead of "begin" in a question prompt.

3.4 Theoretical Framing and Data Analysis

For this study, we attend to both the individual psychological perspective and the social perspective. Bauersfeld et al. (1988) defines the social perspective to be an interactive view of classroom and communal engagements. von Glasersfeld (1992) identifies the psychological perspective to be a constructivist view of an individual's activity. Our research question relies on the integration of both a social and a psychological perspective, since we seek to understand how the community (social perspective) impacted our students' individual affect and behavior (psychological perspective). The synthesis of both of these perspectives is found in a version of social constructivism called the emergent perspective (Cobb and Yackel, 1996). Rasmussen et al. (2015) summarize the emergent perspective as "...coordinat[ing] the individual cognitive perspective of constructivism (von Glasersfeld, 1995) and the sociocultural perspective based on symbolic interactionism (Blumer, 1969)." The interpretive framework, first introduced by Cobb and Yackel (1996) and expanded upon by Rasmussen et al. (2015), allows the researcher to identify components of the social perspectives and psychological perspectives to focus on. However, one must recognize that the relationships found between the social and individual perspectives are indirect, since participation enables, but does not determine, learning. Within this framework, our research seeks to understand how classroom social norms, disciplinary practices, and classroom mathematical practices link to mathematical beliefs and values, participation in mathematical activity, and mathematical conceptions. See Figure 3.4 for the full expanded framework below.

To conduct the analysis of our data set, the tool we chose was an inductive thematic analysis. Thematic analysis, as defined by Braun and Clarke (2012), is an accessible and flexible method of analyzing data. It allows the researcher to "...systematically identify, organize, and offer insights

Table 3.4: Expanded interpretive framework by Rasmussen et al. (2015).

Social Perspective		Individual Perspective	
Classroom Social Norms		Beliefs about own role, other's roles, and the general nature of mathematical activity.	
Sociomathematical Norms		Mathematical beliefs and values	
Disciplinary practices	Classroom mathematical practices	Participation in mathematical activity	Mathematical conceptions
What is the mathematical progress of the classroom community in terms of the disciplinary practices of mathematics?	What are the normative ways of reasoning that emerge in a particular classroom?	How do individual students contribute to mathematical progress that occurs across small group and whole class settings?	What conceptions do individual students bring to bear in their mathematical work?

into patterns of meaning (themes) *across* a data set (p. 57)." Braun and Clarke (2006) further define inductive thematic analysis as "...a process of coding the data without trying to fit it into a pre-existing coding frame, or the researcher's analytical preconceptions (p. 12)." This type of analysis is driven by the data given; for example, even though we may be hoping to find in our data comments about our class and its effects, the students could have instead journaled about their experience using the online interface of PAC*e*. Thus, when we developed our coding scheme, we began our inductive analysis by becoming familiar with the data. This was done throughout the semester since we utilized their reflections in CCES, and then additionally done through the lens of a researcher versus an educator. Then, we identified codes that encapsulate a student's participation, understanding that there may be one segment of data coded a variety of ways. The unit of analysis was the excerpts from the reflective journals, and each excerpt could be coded with multiple themes. Braun and Clarke (2006) emphasize that to be considered a theme something must portray a patterned meaning or response. In order to make sure that our analysis was valid, we triangulated the journal entries with other data previously mentioned, and made sure that the codes and themes were patterned responses accross a majority of students in that population.

Chapter 4

Results and Discussion

The thematic analysis of the journal entries revealed three prevalent themes in the data which were highly correlated: mathematical affect, influence, and behavior. Students entered our classroom with a pre-established mathematical affect based on previous experiences, which influenced their behavior as they interacted with math. The data suggests that one population of students were able to use the influences of our class and the PAC*e* program to positively change their beliefs about mathematics, which allowed them to combat their previous anxieties and lack of confidence to fully engage towards their success in the class. The data also suggests that a different subset of students were influenced via some component of the PAC*e* program and their past math traumas but did not shift their mathematical affect, which may have contributed to them not engaging in and passing the class. This relationship is represented in Figure 4.1.

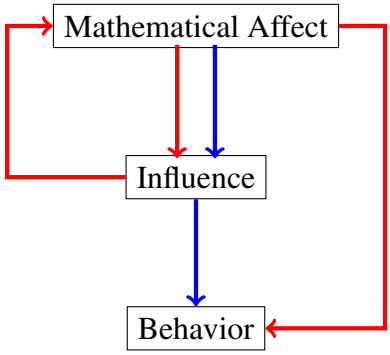

Figure 4.1: Correlation between major themes.

Table 4.1 illustrates these themes, their codes, and subcodes.

In the following paragraphs, we further discuss the analysis performed within each theme by highlighting a subset of codes.

Table 4.1: Themes, codes, and subcodes.

Theme	Code	Subcode	Code Definition
Mathematical Affect	Anxiety	Math Anxiety	Comments about a student's anxiety when discussing math
		Test Taking Anxiety	Comments about a student's anxiety when discussing tests
	Confidence		Comments about the varying levels of confidence in their ability to succeed in PAC*e* and engage with mathematics
	Enjoyment		Comments about the level of enjoyment (if any) while doing mathematics in MATH 117
Influence	PAC*e*	Delivery of Material	Comments about the way the material was taught, e.g.the instructor videos, the use of a calculator, the online text
		Formatting	Comments about the formatting, specifically focused on student's inputting answers on the online interface
		Messaging of Requirements	Comments about the student's understanding of how the PAC*e* system operates
		Exams	Comments about review, unit, and final exams
		Speed	Comments about the speed of the course
	In-Person	Peers	Comments about their peers in the in-person section
		Instructor	Comments about one/multiple members of the instructional team
		Class Time	Comments about the time spent in Tuesday's class and Thursday's review
	Outside	Previous Instructional Experience	Comments about a mathematical experience that happened in the past
		Peers	Comments about peers that are not in MATH 117-002
		Family	Comments about their family.
Behavior	Engagement with Resources		Comments about the student's tendencies to utilize the resources provided
	Engagement with Material		Comments about the student's varying levels of participation (or lack of) with the content
	Metacognitive Adaptation	PAC*e* System	Comments about their ability to adapt their study habits to be successful in PAC*e*
		Mathematically	Comments about their ability to adapt their learning habits to understand the mathematics

4.1 Mathematical Affect

Within the first theme of mathematical affect, there are three major codes: anxiety, confidence, and enjoyment.

4.1.1 Anxiety

Simply searching for "anxiety" in the data, we found that it was directly mentioned at least once per student and a total of 184 times. Additionally, there were countless other implicit instances of anxiety woven within the entries. For reference, the word "math" was found a total of 68 times or three times less. The students mentioned both math anxiety and test-taking anxiety, but as the literature mentioned, these frequently manifest together (Ashcraft, 2001). Poppy's excerpt of "trying to look at a math problem and not knowing the step by step instructions makes me anxious, knowing how to halfway solve the question makes me anxious, everything in math makes me anxious" highlights a common trend of our students feeling lost when they are unsure how to start the problem. Connie goes more in depth as to how the anxiety physically affects her, stating "I think math is so complicated and stressful it makes me want to curl up and cry when I don't understand what I'm being taught." Eleven of the students also mention having test-taking anxiety. Jordan states "I have always had test anxiety for all subjects, but for math more than any other subject. As soon as I sit down to take the exam it is like I have forgotten all the math I had been learning for the exam." Overall, every student expressed having some level of anxiety when it comes to math.

4.1.2 Triangulation of Anxiety with A-MARS

To further quantify these anxieties and triangulate the data, we had our students fill out the A-MARS at week two. We chose three different subsets of questions from the survey to analyze. One question, with the results shown in Figure 4.2, asked them to rate the anxiety based on "taking an exam (final) in a math course," to which 75% (21 total students) responded with the highest value of "very much." This data validates the prevalence of the students' anxieties expressed in

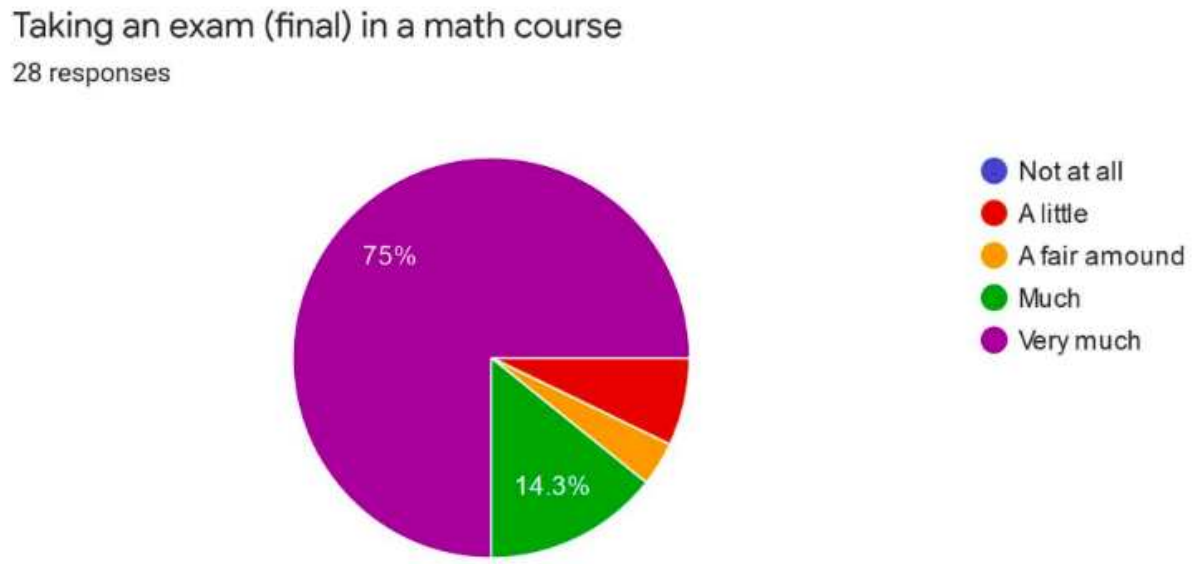

Figure 4.2: A-MARS Results.

their journals. Not a single person chose the response "not at all." Only 7.1% chose "a little," 3.6% said "a fair amount," and 14.3% responded with "much."

Additionally, we analyzed student responses in regard to their anxiety in the following two areas: "picking up a math textbook to begin a difficult reading assignment" shown in Figure 4.3 and "opening up an online textbook to begin a difficult assignment" shown in Figure 4.4. The latter was our own construction and not an original question from the A-MARS. We were curious to see if there was a difference in the level of anxiety a student experienced depending on if the resources were physical or online. As shown by the figures, while only 37% of students marked a physical text as "much" or "very much," 53.6% of students marked an online text in those same categories. The percentages for the three less anxious categories "not at all," "a little," and "a fair amount" were all lower for an online text when compared to the physical text.

The last question we wanted to highlight was "being given a set of subtraction problems to solve" shown in Figure 4.5. Unlike the last observations, the highest response was "not at all" with 71.4%, and the response "a little" earned 17.9%. Together, these indicate that almost 90% of students felt little to no anxiety about subtraction. With the other three prompts, the mathematics

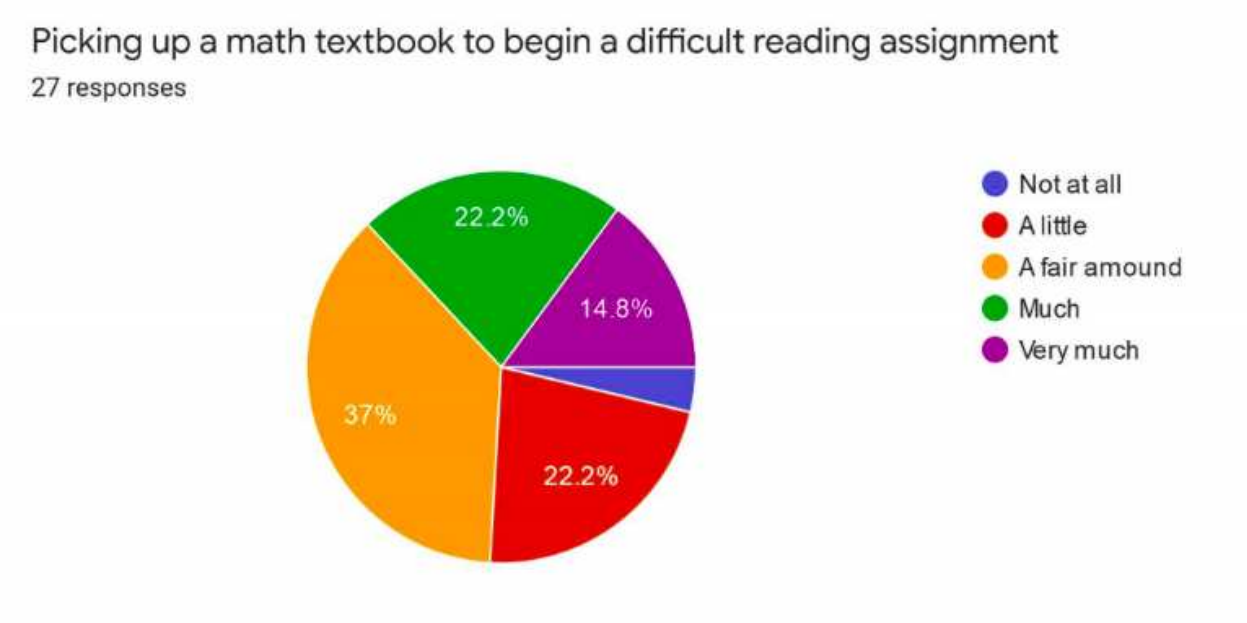

Figure 4.3: A-MARS Results.

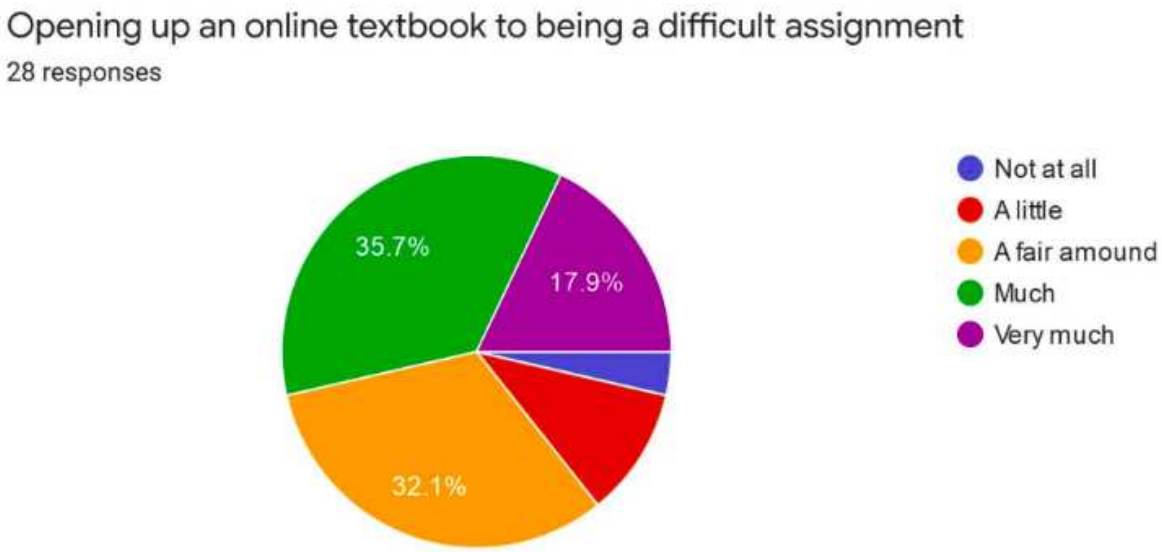

Figure 4.4: A-MARS Results.

were not specified; the final, the physical text, and the online text all could have been sets of subtraction problems. In each case, the abstract concept greatly heightened the anxiety faced by our students. We see here that since the students were aware of what they would be asked (subtraction), we can deduce that their confidence in their ability to subtract quells, or at minimum reduces, the anxieties and phobias they have towards mathematics.

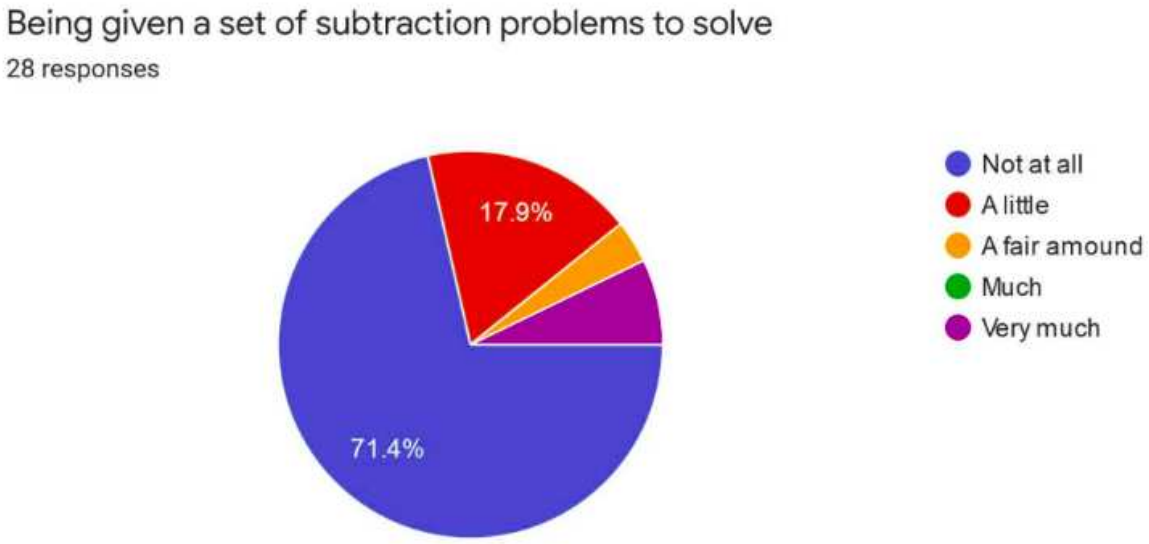

Figure 4.5: A-MARS Results.

4.1.3 Comparison of Anxiety Across Groups

While population A started off just as anxious as the other two populations in the beginning of the course, they were able to not only push through the anxiety, but appeared to heal previous mathematical traumas. When asked to reflect on where they were at week ten versus where they were at week one, Halle's quote reflects the general consensus among population A, stating "though I'm adjusting to PAC*e* slowly and steadily, I am thriving. My math anxieties have been quelled for the most part. I am comfortable asking for help and grateful for feedback." While population B had small victories during the semester (which will be discussed more in the confidence code), their anxieties appeared to persist. Valerie's quote emphasizes this when talking about the final, stating

"I have been studying as much as I can over break but I fear I will still be unable to pass." The trend for population C seemed to be that they hit some sort of roadblock which validated their anxiety, and encouraged them to disengage with the class. For example, Jordan states "taking the skills review exam did make me nervous for the exams to come because of how much stress it caused"; she never took an exam after the unit one review exam.

4.1.4 Confidence

This leads us to now discuss the code of confidence. A prevalent trend in the data was that students lacked confidence early on in the semester. Halle exemplifies this, responding "...I've simply managed to convince myself that no matter what level of preparation and understanding I'm sitting at, I am not ready for whatever my math class may be focusing on... my poor experiences with math in the past have led me to believe I'm just not good at math, despite me knowing that isn't the case." Her quote also shows the most common reason why these students had such low confidence: their past mathematical experiences being poor.

4.1.5 Comparison of Confidence Across Groups

As students in population A continued to make it through each unit and prove to themselves they actually could succeed, they gained more confidence; Shelby reflects at week 10 of the semester that "since the start of the semester I've definitely gotten more confident in my mathematical abilities and I am optimistic for the future of my math career," while Ariel writes after passing the course "I finally felt confident about math like I used to in middle school... thanks to this class I was able to feel confident." Population B showed a bit of confidence midway through the semester once we started the MATH 117 content, but it was much weaker than the confidence shown by population A. A good example of this was from Valerie, who writes "While taking the skills review exam, I felt more confident about my ability to do well in the course." The difference between the confidence gained by the students in population A (versus population B) was that it transcended the situation they received it from; they felt confident in a more abstract mathematical setting which made the feeling more permanent, while students in population B felt confident only

as a result from that specific situation, making the confidence more volatile after a less successful experience. While a few people in population C mentioned feeling confident at week five (where we had an in-class discussion about how the rest of the semester was going to look), there is no strong evidence that they experienced a mathematical situation that made them feel confident.

4.1.6 Enjoyment

The final code in this theme is enjoyment; however, at least at the beginning of the semester, students primarily expressed how much they did not enjoy mathematics. In fact, 10 different students, with at least one from each population, mention in some context that they "hate" mathematics; Sasha displays a representative sentiment when she says that "having excelled in everything else, I have fostered a very hateful relationship with mathematics." Something of interest is that, in the very first journal, three students reveal a yearning to change this hateful sentiment: Jessica "I hope my math story ends in success"; Montana "I just want to be able to say 'I like math'"; and Ariel "After all of that I just want to be able to be confident in doing math." Even though each of these students previously mentioned the circumstances that caused them to dislike math, they still wanted to change. This desire was likely a motivating factor to these three students being in population A.

4.1.7 Comparison of Enjoyment Across Groups

Over the course of the semester, as population A experienced success, their enjoyment also grew. An example of this is Montana saying "Since then, I surprisingly have a joy of doing math?" ten weeks into the semester. Only halfway through the course, she still demonstrated an ability to shift mindsets about mathematics. Enjoyment also was evident in less direct ways, as when Orina wrote in her last journal entry "I am a master" after completing the course. Population B was split; while Sasha experienced some moments of joy "being someone who consistently failed math tests since the third grade, and seeing that you've gotten a 9 out of 10 on one is incredible. I called my mom as I got out of the PAC*e* center, feeling incredibly proud of myself," Valerie only showed frustration "I feel that in the end, I am not actually learning anything but simply trying

to pass a course." Finally, population C mentioned frequently being frustrated either by the Unit One Review Exam or the Unit One Exam. Kylie reflects that "I am used to getting frustrated with mathematics, but trying to get more than a 6 out of 10 on the exam after trying previously about 4 times and getting the same score was actually infuriating." An important thing to recall is that population C never made it past the exams in the first unit; their lack of enjoyment and increased frustration likely contributed to their presence in that group.

4.2 Influence

The next major theme we discovered in the data is influence. This theme represents the various external influences that our students encountered. These experiences encompassed both the influence of people and of the PAC*e* system (which includes our classroom component). When discussing the impact of other people, we include the instructors and peers involved with our class, the instructors and peers from their past, and their current relationships with friends and family. When discussing the impact of PAC*e*, we focus on both the experiences our students had interacting with the system (including the interface) as well as their experience of being in a physical classroom.

4.2.1 Outside Influence: Previous Instructional Experience

While we will not focus on each code and subcode in depth, one subcode that indicated a significant impact was previous instructional experience, in both positive and negative directions. Given the prompt to "describe your worst or most challenging mathematics experience," 12 students attributed their worst or most challenging mathematics experience to an unsupportive and generally poor instructor; in fact, a majority of the data in this subcode is about a negative experience with an instructor. Some students, like Brendan, commented on the lack of instructional support from the teacher; "I ended up having a teacher that didn't really teach the class, but mostly just gave us worksheets and had us watch videos to learn exactly what we were doing." Others, like Merida, described a traumatic experience; "opening up to a teacher and being so flatly rejected

was horrible, and only made me pull away from math and school even more." On the other hand, 8 students responded to "describe your best or most successful mathematics experience" with a positive instructor experience. The common qualities of these teachers were their dedication to and belief in the student; Luis reminisces that "I had amazing teachers that believed in me and provided me with the proper guidance I needed to be successful in their classes." Though classroom observations lead us to conjecture that the main impact these instructional experiences had on their behavior was the ability or lack of ability to feel comfortable asking for help, there is insufficient data in the collected journals to verify or falsify this claim.

4.2.2 PAC*e* Influence: Formatting

We next focus on some of the subcodes within the PAC*e* code, starting with formatting. When the students first experimented with the interface, they both disliked how confusing it was to use and how simple input errors gave them no credit; Shelby states that "I really dislike the PAC*e* format and how specific and weird it is. I have a feeling I am going to be spending a lot of time getting used to it," while Halle replies "...though it was nice to see I hadn't actually done any of my math wrong, it was frustrating to see I had missed a question simply because I forgot to type another 3." However, students in population A had eventual success with adapting to the formatting. While we will discuss this further in the behavior theme (specifically under the metacognitive adaption and mathematics codes), three weeks after Shelby's initial comment, she says "I have been able to get the hang of PAC*e* formatting so I am making less messy mistakes."

4.2.3 PAC*e* Influence: Speed

The next subcode of interest is speed. Within PAC*e*, there are specific deadlines for the review exams that need to be met in order to earn points. Since PAC*e* is a cumulative point totalling system, missing these points can be detrimental to a students' grade. In addition, access to the review exams are locked unless students have both completed the required homework of that unit in addition to passing the previous unit's proctored exam. With the first deadline not starting until the end of October (week 9) and the last deadline occurring in early December (week 13), there

was not a single population that felt comfortable nor adapted to the speed of the course; see Table 4.2 for more detailed information. During week 7, Olivia (from population C) mentions "I feel like it's happening so fast but I just have to get used to it because that is the pace of this type of course." During week 9, Valerie (from population B) states "with the tight schedule comes so much stress because I feel as if I have to rush through what I am learning." Even in week 11, Jessica (from population A) embodies this shared sentiment, responding "with PAC*e* I seem to take five steps forward and I am doing great and then all of a sudden, I am ten steps back wondering how did this happen." Overall, the perception of the course's speed stayed constant throughout the semester, and this is something that we are cognizant of to help students in future semesters.

Table 4.2: Exam dates from the Fall 2019 semester.

What is due?	**Date**
Unit One Review Exam	10/24
Unit Two Review Exam	11/04
Unit Three Review Exam	11/13
Unit Four Review Exam	11/22 changed to 12/3
Final	12/6

4.2.4 PAC*e* Influence: Exams

The last subcode we will discuss within this code is exams. The exams code had a high correlation both with the anxiety code in mathematical affect and with the metacognitive adaption (mathematical and PAC*e*) code in behavior. This makes sense since PAC*e* is structured around exams: 100% of their grade is based on exam performance, and access to future exams is prohibited until a student passes the previous exam. This can cause great frustration for the students, and certainly not all of the students are as resilient as Sasha to take an exam 47 times to pass. In fact, a simple search for the word "exam" yields 429 results, meaning it is a highly mentioned topic. Students from every population mention the exams being tough with a particular emphasis on the proctored exams; Montana (population A) exemplifies this with the following excerpt: "I think the one thing I am struggling with in PAC*e* is just passing the proctored exams." The amount of work that comes with the number of exams in contrast to the class being one credit is also a prevalent

trend in the data. Luis (population A) critically analyzes his workload in week 11, stating "the amount of work, time and energy in PAC*e* is ridiculous. I put in more time in PAC*e* than any other class. The PAC*e* system is only around to test and that is not right. I am stressing about a quiz every week because of PAC*e* and it is only a one credit class." Overall, exams are a prevalent topic mentioned across all populations, and are conjectured to be a key reason why students either combatted or succumbed to their anxieties by engaging or avoiding PAC*e*.

4.2.5 In-Person Influence: Class

The final code in the theme of influence is in-person; this code represents the sentiments about all components that were unique to our section of MATH 117. In regards to the class itself, initially, many students came in thankful for the opportunity, citing either poor previous online experiences or wanting the additional in-person support. However, after a few weeks, some students were expressing disinterest, or were becoming completely disengaged from the group work we were doing all together. Jessica replies that "I am happy there is a class about how to use PAC*e* and help us study for it, but as of right now we are not doing that." Finally, after our conversation at week five, the students express again that they are thankful for the class, and previously withdrawn students comment on re-engaging. We conclude with Montana stating "It's a great thing and now I'm ready to go for it."

4.2.6 Comparison of In-Person Class Influence Across Groups

In fact, there is no negative comment made by anyone past week five about class time. Mostly, students from Population A express that they are thankful for the Tuesday class, and they start realizing the benefit of attending the optional Thursday review sessions. Brendan reflects about his experience working through unit one by saying "class time on Tuesday and Thursday was very helpful for getting through these assignments and it was nice getting help…" The reasons they are thankful include: the help provided from the instructional team, the relationships they formed with peers, and the accountability check going to class provided them with. While Populations B and C mention enjoying the class time and the help that was provided, their lack of responses and spotty

attendance makes it unclear whether they actually benefited from the class time. However, we will see in the following sections that these populations were positively influenced by the instructional team and their peers. We conclude this section with an excerpt from Halle about her final reflection on the class:

> I believe if more students were offered an in-person PAC*e* class, the PAC*e* system would be a more functional system for all. This class was likely the difference between me passing and failing PAC*e*... I believe this class should be offered every semester, because the PAC*e* system was not constructed for the benefit of students who struggle with math... I'm being entirely genuine when I say I believe this was the most valuable class I had taken this semester. I have been taught patience, time management, self-responsibility, and, of course, math.

4.2.7 In-Person Influence: Instructor

The subcode of instructor encapsulates the influence that any member of our instructional team had on a student. Not a single student mentioned something negative about the instructional team. While it is important to acknowledge there might be bias in the data collection since they were submitting the journals to me (a member of the team), based on the students' honesty in previous journals, we are led to believe that this is a significant finding. All populations mention positive interactions with the instructional team. The two major areas where we provided support were mathematically and personally. Montana (from population A) describes being supported mathematically, stating "I met with [Mandie] on Monday and it actually helped a lot and I'm really grateful that she contacted me about help because in the mood I was in, I knew I wouldn't make the effort." Olivia (from population C) describes feeling supported personally, responding "I had some help from [Valerie] and Jess in reminding me that I knew what I was doing, which really did help me so much... If I didn't have Jess I feel like I wouldn't be able to do it, so I'm glad that she was there to guide me and not make me feel like I was lost." Finally, Valerie (from population B) describes having both supports in the same instructional experience, stating "Whenever I began to

struggle, [Tony] was eager to help me either by showing me an easier way to go about a problem, or simply offer the support and reassurance while I was going through a problem myself." Overall, we conjecture that the positive influence of the instructional team led some students towards more conducive behaviors for their success; we will discuss this in more detail in the behavior code.

4.2.8 In-Person Influence: Peers

The peers subcode represents the students' interactions with other students in our in-person class. Note that this is a different subset of students than just those that are taking PAC*e*. In the beginning of the semester, most likely due to the influence of previous instructional experiences, a majority of students are afraid to admit that they don't understand something for fear of being judged by their peers; Jessica exemplifies this by sharing "...the last thing I need is for the whole class to hate me because I am not understanding what is being taught." A few students even falsely compare themselves to their peers and believe they are the only ones who don't understand something. From Montana's excerpt, she states that"...my classmates obviously are more ahead then I am and it really just makes me feel awful about myself." After the conversation at week 5, however, many students begin to feel supported by their classmates; Connie mentions "after class on Tuesday it felt very good to know that I wasn't the only one struggling with math, I'm very antisocial so coming into class alone and sitting alone and seeing everyone else going ahead onto the next problems I felt alone but realizing that this was a place of comfort and I wasn't the only one who struggles felt good." We next analyze what happened across the populations after week 5.

4.2.9 Comparison of In-Person Peers Influence Across Groups

While students from all populations felt more comfortable around their classmates after week 5, only population A shows a long lasting influence from their peers. Luis attributes this to his success in the course, responding "I thought that I was going to fail this math class but everybody even the other students got me through it. We all pushed each other and I feel like that was the only way we got through a lot of it." Some students formed more personal relationships with each other, which helped them hold each other accountable. For example, Montana and Sharna (both

from population A) started referring to each other by Journal 7, and are still continuing to work on PAC*e* together in subsequent courses. Valerie (population B) and Olivia (population C) also worked together for a class and talked about how it was a helpful relationship. Unfortunately, Olivia stopped showing up to class, which could be a reason why Valerie was in population B and not A. At some point, some students in the class made a group chat over GroupMe; while we are unaware of who participated in the GroupMe, a few students from population A mention it being helpful in their journals. Overall, having a solid rapport with their classmates was a key factor in population A's success, and a potential contributor as to why students in populations B and C didn't have as much of a connection to the class as a whole.

4.3 Behavior

The final theme in the coding scheme is behavior. This theme entails the actions or inactions taken by students in our class. The three main behaviors we were able to observe in the data and our codes for the analysis are: engagement with resources, engagement with material, and metacognitive adaption. While we will focus on the metacognitive adaption code in depth, we will first briefly describe the two types of engagement.

4.3.1 Engagement with Resources

The resources provided by PAC*e* include, but are not limited to, instructional videos, PDF notes, TI-84 calculators, and Course Assistants trained in the PAC*e* content that hold office hours during the Learning Center's hours, while the resources provided by us were Tuesday's class and Thursday's review. One point of interest is that there are students in each population that mention both liking and not liking the videos; however, only students in population A and Valerie (from population B) who didn't like the videos mention finding outside instructional content.

4.3.2 Engagement with Material

With engagement in the material, there was a point in which the students in populations B and C stopped participating; the last time anyone from population C made progress on PAC*e* was 11/5, and from population B was 11/18; the last journal entry a member of population C wrote was Journal 11, and population B was Journal 12. Those in population A made consistent effort to be engaged both in journaling and in making timely progress in PAC*e*. Overall, the ability to engage both with PAC*e* and the material took both thoughtful insight as to what they needed to do, as well as the capacity to enact such a change.

4.3.3 Metacognative Adaption

We recall that Flavell describes one of three facets of metacognition to be metacognitive experiences, which refer to the feelings and awareness surrounding a situation that requires problem-solving (1979). What we mean by metacognitive adaption is the ability for the students to recognize these feelings and actively change their behavior to either accept or reject these feelings. We analyze two different types of behavior change: one in regards to PAC*e* and one in regards to mathematics.

Metacoginitive Adaption: PAC*e* System

The first type of metacognitive adaption was their change in behavior towards using PAC*e*. The sheer volume of small nuances of the PAC*e* system can be extremely daunting; for reference, see the newly shortened 20 page Student Guide. That being said, students being able to understand how the system works and adapt in a way that is conducive towards their success is no easy feat. Most of population C showed no signs of metacognitive adaption towards PAC*e*. While there were a few students in population C that were able to realize the metacognition needed, they proved unable to adapt. For example, Trent mentions "I used my failures to see where I went wrong with my math, and took advantage of the various question examples that PAC*e* had provided me as I failed the exam." After taking an exam, PAC*e* gives the student an electronic copy of the exam with their answer, the correct answer, and the solution to each problem. Though Trent was able to realize this,

they were unable to implement the behavior, never taking an exam past the Skills Review Exam. Students in population B showed the ability to adapt their behavior using metacognition gained from doing PAC*e*, however, at some point they stopped enacting this behavior. Emily displays this behavior when she describes her experience taking the Unit 1 Proctored Exam, stating "the second time I took it, I got a 5/10, which had obviously dipped quite a bit from the first time, but most of the mistakes I made were small and I just needed take my time." Students in population A were able to metacognitively adapt throughout the semester in various ways. Many of them reaped the benefit that PAC*e* allows you to retake exams and that it keeps the highest score. Shelby shared "I like a lot that PAC*e* lets you retake things until the perfect score is achieved. I think it's a good way to get in extra practice, it helps me fully understand the material, and also acclimate to the PAC*e* formatting." Many students realized along with Halle that practicing the review exams was helpful since "the questions given on my exam were carbon copies of the questions I had seen in previous homework and review exams…" A few students, such as Orina (population A), took this even further, mentioning that "I usually take the review exams about 15 times before I take the proctored exams… I have passed the proctored exams every time on the first try." Rhea (population A) even realized that, since there is no penalty for failing the final exam, she could go in before Thanksgiving break and submit blank copies of the final to get something to study (which she later shared in the GroupMe with her peers). Overall, this first type of metacognitive change required the students to learn situated behaviors to be successful in PAC*e*.

Metacognitive Adaption: Mathematically

The second type of metacognitive adaption was their ability to, in a sense, learn how to learn math. These are behaviors disjoint from PAC*e*, where they could utilize these behaviors in any future mathematical context. Simon, from population C, has the capacity to have these metacognitive thoughts, but does not enact them (similar to the previous section's findings), recalling:

> I had a hard time understanding most of its contents, in the past I would usually give up and try to find an easier and less challenging way to complete it like having someone

else do it for me. But I knew that would just set me up for failure in the later sections and in the proctored exam, so I decided to keep pushing through.

There is not conclusive evidence to analyze the change in behavior of population B. However, population A consistently showed the ability to learn behaviors that helped them learn the content. Sharna observes that "not looking at my notes will help me truly see whether or not I understand the content and steps I need to take to correct my work", while Ariel discusses an indirect behavior, explaining that "there are times I get frustrated but I just refer back to the tips and techniques [see appendix] that were given to me and not allow that one problem define my math success." These adaptions are one factor that led to the success of population A.

4.4 Case Study of Montana

To wrap up the results in an illustrative way, we share an in depth case study on Montana, a student from population A. She was selected due to having a large and rich data set; she didn't miss a journal entry (though her response to Journal 13 was more constructive criticism about the physical structure of the PAC*e* Center so there was nothing in the journal that fit the coding scheme), and her sentiments strongly reflect that of the majority in each part of the timeline. A qualitative data analysis software, MAXQDA, helped to create plots identifying the frequency of a code over a period of time; since the data set is continuous longitudinal data, we can use these graphs to see changes over time throughout the semester. An additional feature to the coding scheme that we added in the software was to mark whether the code was positive or negative. This feature is added because, for example, both the negative sentiment "I always try to have a positive attitude about math but lately, it has just seemed more as something I don't want to do at all" and the positive sentiment "since then, I surprisingly have a joy of doing math?" would be coded under enjoyment. While this is fine for a descriptive analysis, looking at frequencies would be convoluted if we didn't understand what context of the enjoyment code was occurring.

Figure 4.6 represents all codes in the theme mathematical affect. During the first four weeks, Montana's journals are heavily negatively coded. In the beginning, she is describing her mathemat-

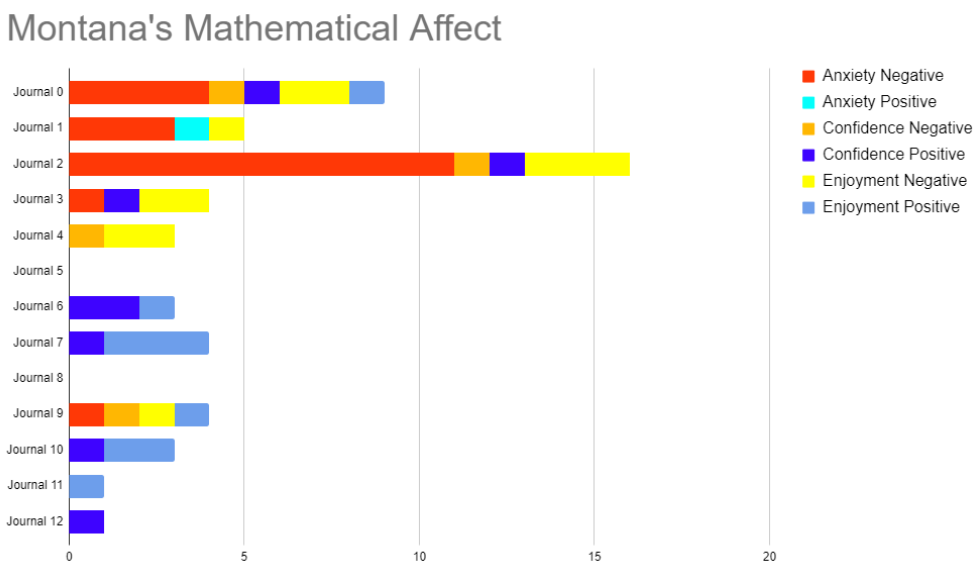

Figure 4.6: Montana's coded mathematical affect.

ical affect influenced by previous instructional experiences. However, her beliefs were not changed (and were potentially reinforced) during the first four weeks of instruction. Past Journal 5 (with the exception of Journal 9) Montana experiences all positive codes, specifically of enjoyment and confidence. The gap at Journal 5 is because she spent the whole journal thanking the instructors for listening to her criticism and working to give the student's agency in the classroom and the gap at Journal 8 is because she was writing about her experience in the Learning Center; we will discuss this more in the influence and behavior themes. The reason for the spike of negative affect at week 9 is due to the fact that this was when their Unit One Exam was due. Since this was the first proctored exam, and Montana had to retake the Review Exam at least once- a frustrating moment for her. However, when prompted about other exams (including the final), she didn't experience any negative mathematical affect. To conclude, we note that even when Montana was experiencing a high volume of negative affect, she always had a portion of (positive) confidence. A conjecture we make is that Montana had the confidence to know she could succeed, but she needed to be supported in the right environment to be capable of success.

Figure 4.7 pertains to the influence theme, with a specific focus on the in-person subcodes of class time and peers. As shown by the graph, Montana was hopeful in the beginning of the

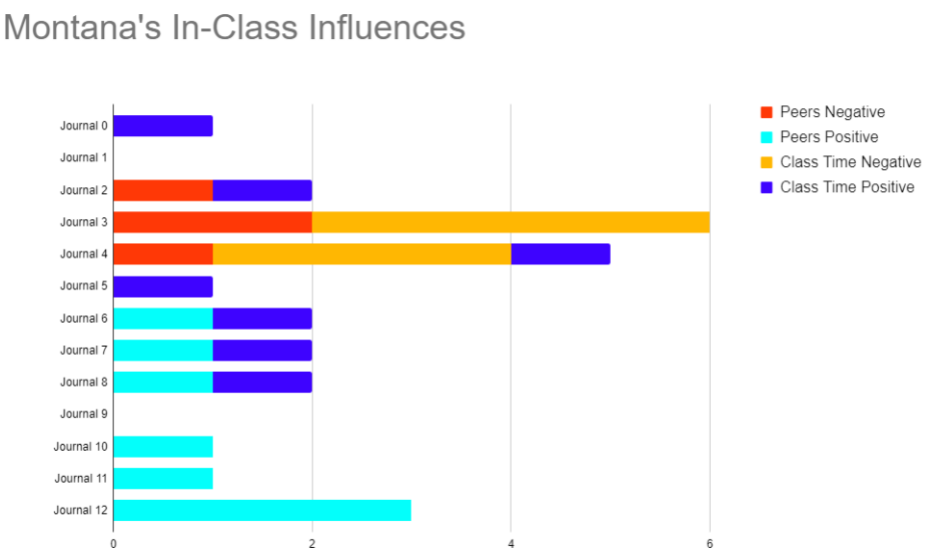

Figure 4.7: Montana's coded in-person influence.

semester that this class would be helpful; however, she quickly and drastically realized that the class was not conducive and actively harming her ability to succeed. We see that once the class shift was enacted, Montana did not have another negative experience in our class, and was actively able to receive positive influences both from her peers and from her time spent in class. We note that the consistency of the "peers positive" subcode is from the strong relationship she forms with Sharna at week 7. We also note that the gap at week 9 is due to her expressing her frustrations with the Unit One Exam.

Figure 4.8 focuses on the resources subcode in the behavior theme. In the beginning, Montana's interactions with the resources provided were infrequent and negative. At week 6, however, we see that Montana positively engaged throughout the remainder of the semester. The gaps in the data are representative of weeks where Montana might not have needed additional resources. The one negative interaction Montana had with resources was during week 9, where she had a bad interaction with a PAC*e* course assistant. Nevertheless, she was able to persevere, pass the Unit One Exam, and continue to engage positively with the resources provided to her for the remainder of the semester.

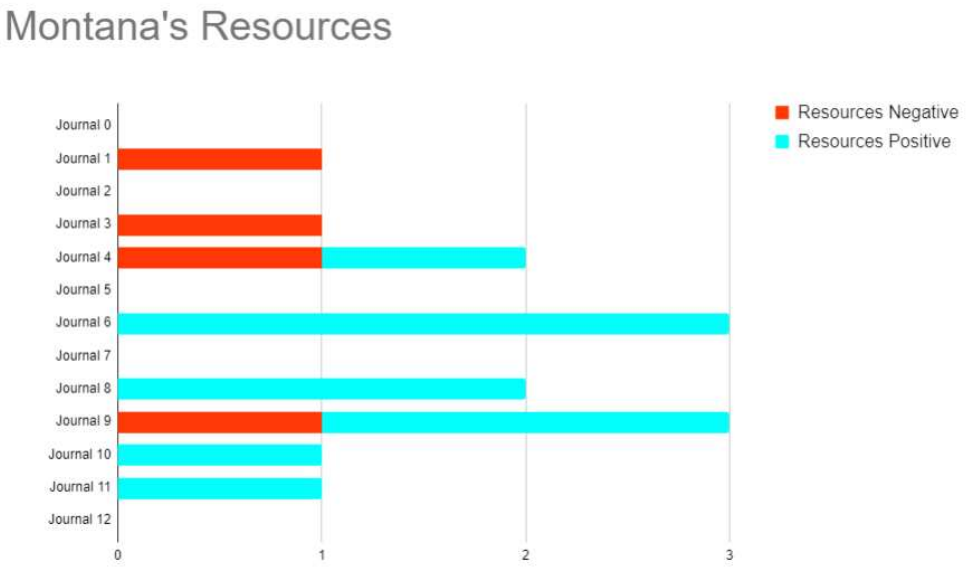

Figure 4.8: Montana's coded engagement with resources.

Chapter 5

Conclusion

Overall, through the lens of the emergent perspective, we were able to identify ways that our supplemental, in-person section and the PAC*e* program impacted students' mathematical affect and ability to pass MATH 117. Understanding the literature behind student struggles (such as lack of discipline and engagement) with online instruction, as well as typical causes for poor mathematical affect and how to avoid inducing more anxiety led us to develop supplemental instruction that helped a portion of our students combat these typical issues. For the populations that did not pass the course, we utilized the comparison of data across the different groups to identify common trends, probable causes, and likely implications to helping future students succeed. Without the use of the emergent perspective, we would be missing key connections between the psychological and social perspectives in our data (for one example, consider the relationship between Sharna and Montana and how it increased their personal enjoyment of the mathematics). These analyses support the position that this experimental course should continue to run, so that we can refine our course structure to positively impact more students, as well as gather more knowledge and data with the CSU-wide population that is impacted by PAC*e*. In this section, we discuss future work that can be done, give a brief synopsis on the successes and challenges of the second pilot semester (Spring 2020, not a part of this study), and end with some concluding thoughts.

5.1 Future Work: Agency as a Theoretical Lens

Our research questions asked us to analyze how students were impacted, so utilizing the theoretical lens of the emergent perspective in conjunction with the codes created in our thematic analysis was extremely beneficial for answering that question. While we have made a few conjectures as to why students were impacted certain ways, agency as a theoretical framework with a different coding scheme would better allow us to answer this question. Emirbayer and Mische (1998) define agency to be "the temporally constructed engagement by actors of different structural

environments... which, through the interplay of habit, imagination, and judgement, both reproduces and transforms those structures in interactive response to the problems posed by changing historical situations (p. 970)." This definition strays away from the transactional notion that agency is residing solely as something people do and not something people have (Biesta, Priestley, Robinson, 2014). Preistley et al. (2012) further develop this concept of agency being a combination of doing and having by identifying that students attempting to achieve agency need both causes and the capacity to change. Something of interest is the model shown in Figure 5.1 produced by Biesta et al. (2014) which guides the design, data-collection, data-analysis, and interpretation of agency as a framework. This figure draws parallels to the interpretation of how our themes interact with each other. In future work, it would be of interest to study our data through the lens of agency and see what causes and capacities the different populations embodied. Specifically, some research questions we would be interested in are:

- Why was population A able to enact the capacity to change?
- What factor(s) lead the students in population B to
  - have adversity through various hardships in PAC*e*?
  - ultimately not pass MATH 117?
- Why was population C unable to enact the capacity to change?

A brief hypothesis for Sasha from population B is that she actually had the capacity to change, but the timeframe in which she was asked to enact that capacity was too short. Sasha is retaking our class this semester, is already a unit and a half ahead, and has frequently communicated and demonstrated her plans to take steps to continue to be successful.

5.2 Future Work: Professional Development

Another area for future research that would use a different data set would be understanding the impact this course had on the instructional team. I personally have frequently referred to this class

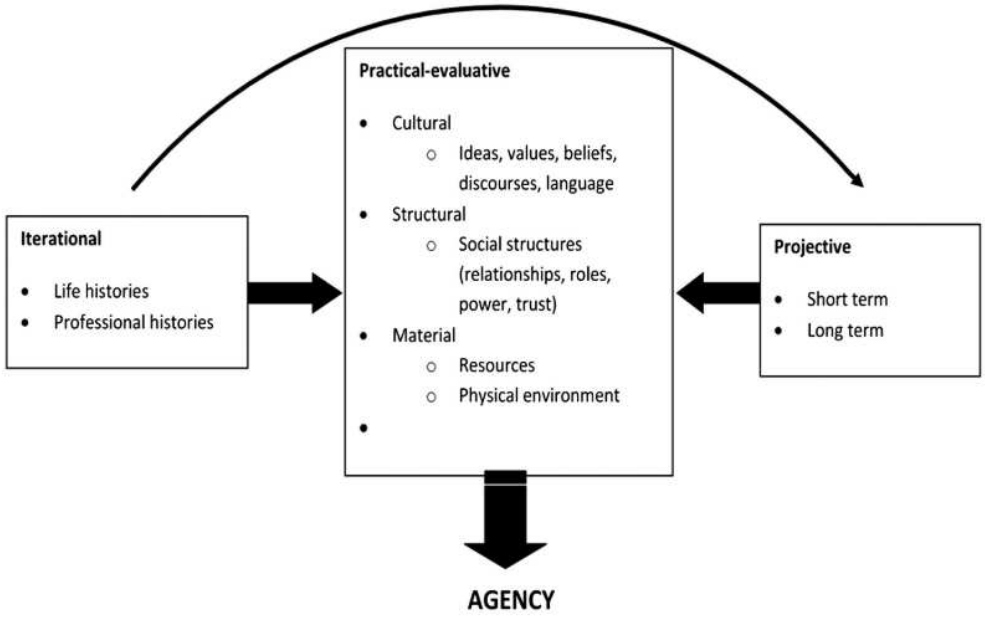

Figure 5.1: Agency as a framework by Biesta et al. (2014).

as the most challenging (yet rewarding) course I've ever taught; before our restructuring at week 5, I would honestly feel physically sick from anxiety before going to this class because I felt unable to provide an appropriate service to the students. However, I was able to combat that anxiety and am now the lead instructor for two sections of this course where I work diligently to support my students individually and collectively as mathematicians and whole humans.

It would be interesting to see how such a participatory and agency-based classroom environment impacted the different members of the instructional team, with a specific focus on Jess and Mandie. As a professional educator and accomplished researcher in math education, Jess expressed having struggles adapting towards teaching this course. She states:

> One of my initial goals for the class was to support students to learn rich mathematics, and so we had students share and compare their strategies for factoring… we realized that not only did this exacerbate some of their anxieties, but it also didn't help them on the exams, and the entire PAC*e* course was structured around students being able to quickly answer procedural problems. They did not need to have an understanding of what factoring was doing, they just needed to have a reliable method for it. Once I

> accepted this, I could help support them in being successful in this course - but I had to check my own beliefs about what a mathematics course should be teaching students. This course was designed to support students to be successful in a system that wasn't designed for them, and so we adapted to learn what it meant to be successful in this system. In other words, we learned how to better support to play the game, which meant we had to play the game ourselves a bit.

The challenge of facing that your values and beliefs regarding mathematics teaching does not align with the goal of student success is extremely tough. Jess' ability to adapt to the needs of her students while finding a balance between rejecting and adapting her beliefs on how a math course should be taught is an interesting type of professional development that could be explored in a future research project.

Mandie also underwent significant personal changes from being involved in this class. Previously, Mandie had failed MATH 118, and since she had placed out of MATH 117, she had never passed a PAC*e* course. She was chosen to be an LA for our class the same semester she was retaking this course along with MATH 124 and MATH 125. Not only was she able to be successful in those courses, she was also able to complete the last PAC*e* course in two days and get into MATH 160 this semester. A life change that happened for her during this experience is that she decided to switch her major from a Neuroscience concentration in Psychology to Data Science. She describes the challenges of math to be exciting and something she doesn't want to stop until she solves. It would be interesting to see what aspects of being a leader in the classroom while simultaneously participating in the same system impacted her to grow to where she is today.

5.3 Spring Semester 2020: Successes and Challenges

While this study took place during the fall semester, there was enough funding and support to run two in-person sections in the spring: one one-credit section where they complete the ELM Tutorial and MATH 117 and one two-credit section where they complete MATH 117 and MATH 118. A difference to quickly note from last semester to the current one is that the students in the

ELM/117 class do not have special permission to access the content of MATH 117; they must pass the ELM Tutorial, which is something new we need to incorporate into our class. The instructional team for the first class consists of me as the lead instructor and two new Learning Assistants: Brittany, a PAC*e* Course Assistant, and Montana, a student from our class last semester. The instructional team for the second class is again me as the lead instructor, with Tony and Mandie returning as the LA's. Because this was the second semester we are running this course, there were challenges we faced last semester that we now have an idea on how to fix. For example, attendance was a big issue in our class; our average out of 25 by the end of the semester was between 10-15 students. Another challenge was that students seemed to have lackluster engagement with email communication; often when a portion of students didn't show up, we would write multiple targeted emails to the different populations outlining strategies for how they could achieve success. Both of these problems were solved by making attendance a small portion of their grade- this makes sense, since if a student isn't going to show up to class, then they can simply take the online version of PAC*e*. Now that most students are attending class on a weekly basis, we can communicate with them in-person, which seems to have a stronger impact. Something else we saw from the previous semester was that Unit 3 was the most challenging for a lot of students. Many students struggled since the content was very calculator heavy, so they would have to both know how to use the calculator and interpret the results they were seeing. To combat this, for the spring semester in both classes we made sure that students had an additional week to work on this material. One last problem we faced was the disengagement in the beginning of the semester when we hadn't started the mathematics content right away. Students were highly in favor of starting the content right away, most likely from a mix of anxiety and readiness to do mathematics, and starting early means the deadlines can be spaced out more. So, in both our classes, we made sure to start material to optimize time and to get the students in the mindset of doing mathematics.

Although we have information from last semester's students, it would be unrealistic to expect there to be zero challenges this semester. The data collected is extremely fruitful towards understanding the global population we are targeting with these courses; however, each class has a

unique dynamic that as an instructor, you can only experience and adapt versus try to prepare for. A way we strategize to figure out this dynamic early on is to give the students agency in shaping the nature of the class. We let them know early on we are not just willing, but expecting to change the structure of the course, so their feedback in this process is greatly appreciated. We give them this ability at any point, though we specifically prompt for their feedback through targeted journal entries, in-class conversations (both in one-on-one check-ins and small groups), and email conversations. Through this process, we allow students to be agents of change: to take power in the classroom and create a space most conducive to them.

5.4 Concluding Thoughts

The final, and arguably most important, finding of this research study is that in order to help an identified population, you need to learn from that population how they want to be helped. There are many exciting changes in the works towards changing PAC*e* that, without insight from our students, may not have occurred. We are now able to recognize in more detail that this is an imperfect system, which further exacerbates the anxieties and frustrations of an already disadvantaged population. Through this work, we can continue to provide a space where these students have power to create an environment conducive to them and their successes. I am thrilled to have been given the opportunity to participate in this study, and look forward to the future impacts that we will have on individual students, the mathematics department, and the entire university.

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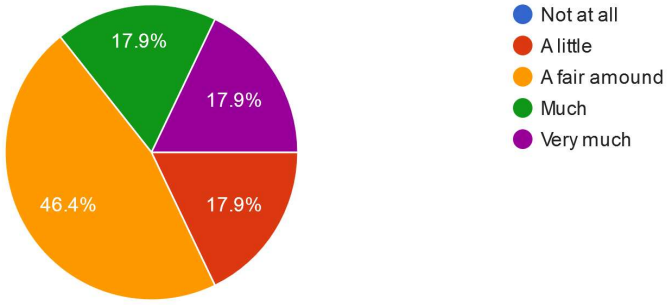
Appendix

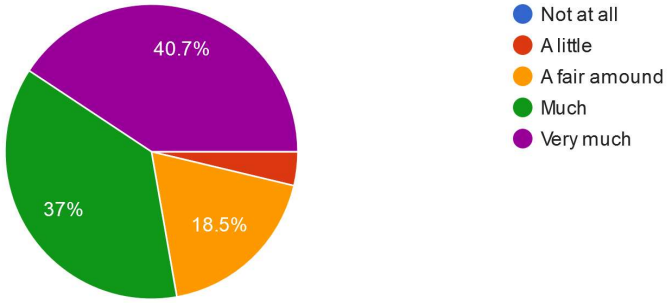
Studying of a math test

28 responses



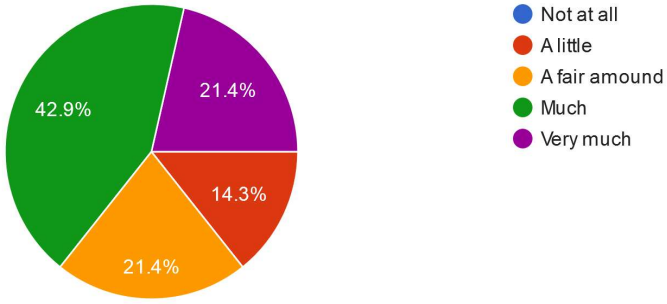
Taking the math section of a college entrance exam

27 responses



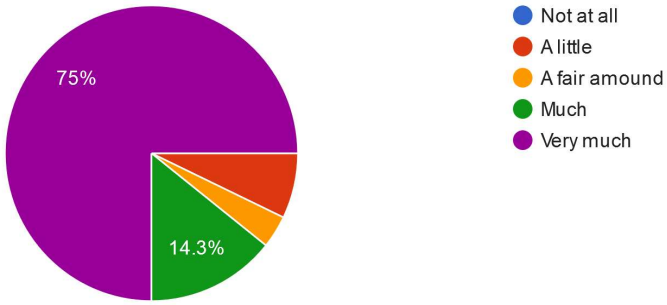
Taking an exam (quiz) in a math course

28 responses



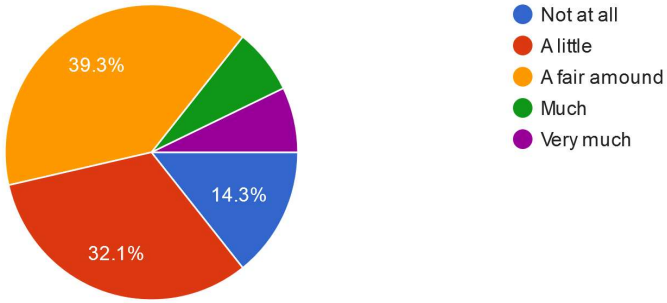
Taking an exam (final) in a math course

28 responses



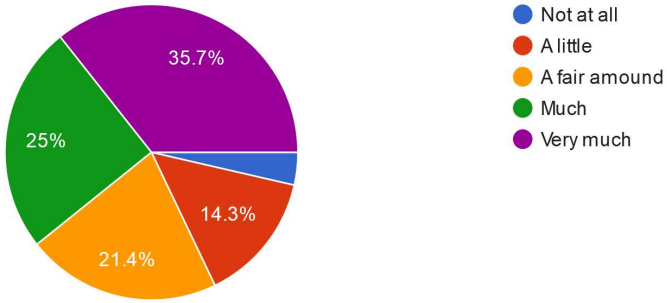
Picking up a math textbook to begin working on a homework assignement

28 responses



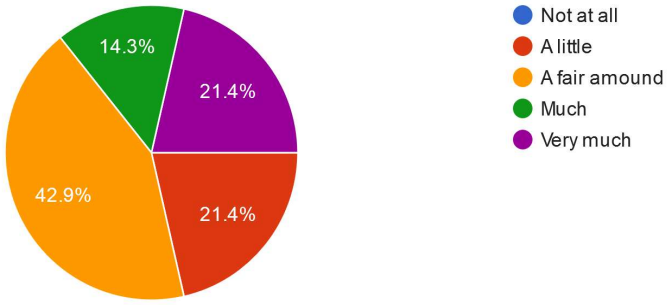
Being given homework assignments of many difficult problems that are due the next meeting

28 responses



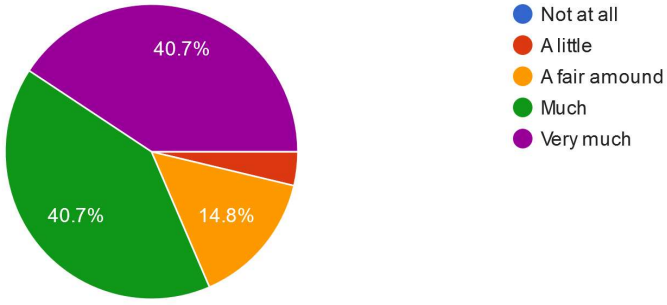
Thinking about an upcoming math test 1 week before

28 responses



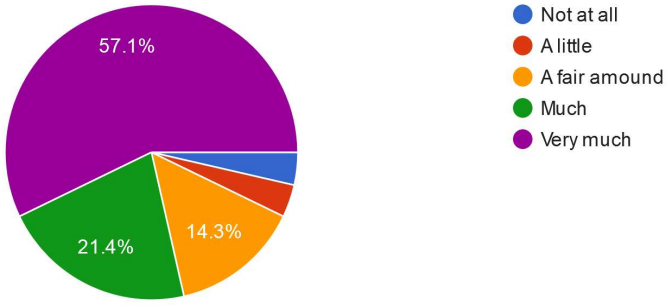
Thinking about an upcoming math test 1 day before

27 responses



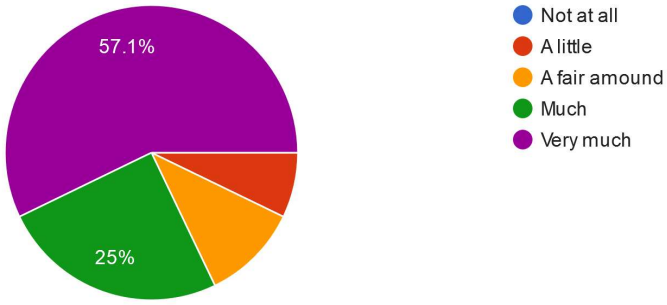
Thinking about an upcoming math test 1 hour before

28 responses



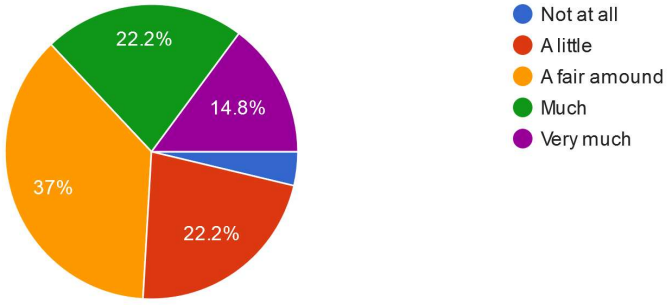
Realizing you have to take a certain number of math classes to fulfill requirements

28 responses



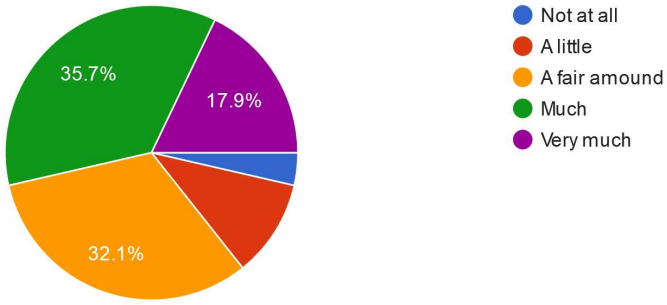
Picking up a math textbook to begin a difficult reading assignment

27 responses



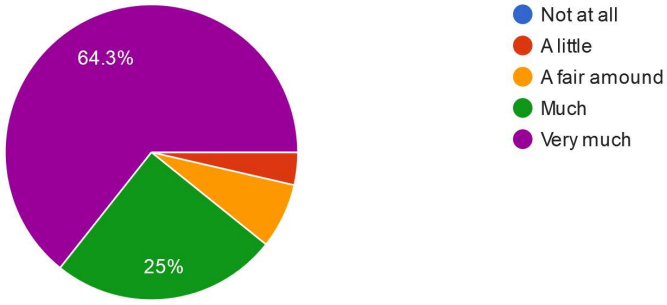
Opening up an online textbook to being a difficult assignment

28 responses



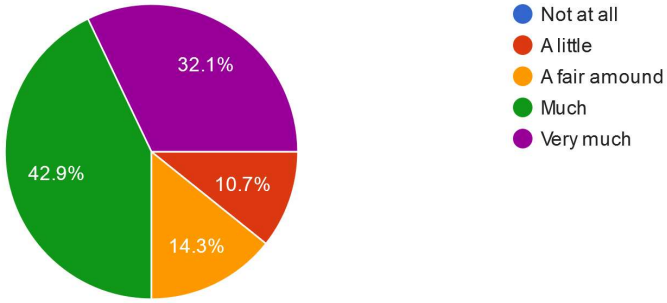
Receiving your final math grade in the mail

28 responses



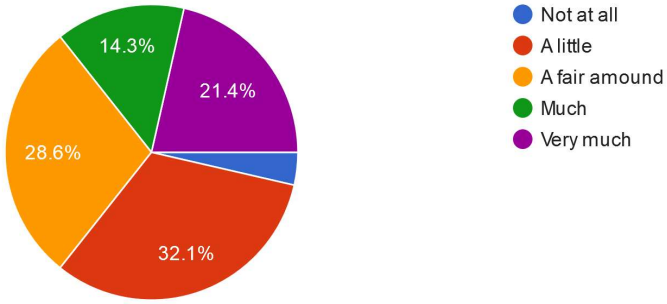
Opening a math or stat book and seeing a page full of problems

28 responses



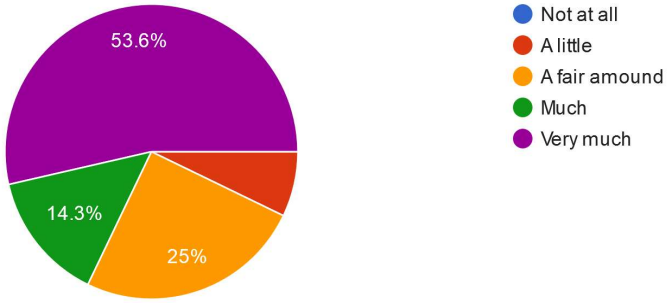
Getting ready to study for a math test

28 responses



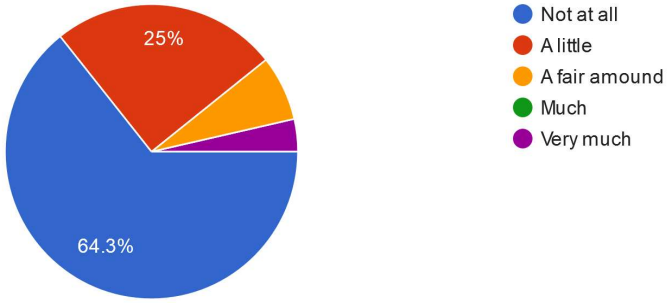
Being given a "pop" quiz in a math class

28 responses



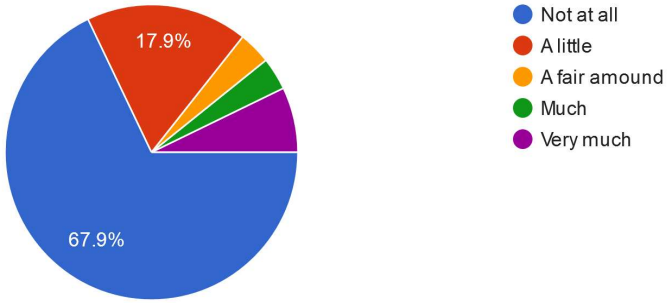
Understanding a cash register receipt from a purchase

28 responses



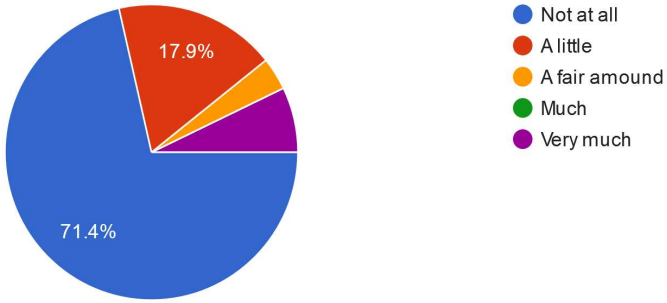
Being given a set of numerical problems involving addition to solve on paper

28 responses



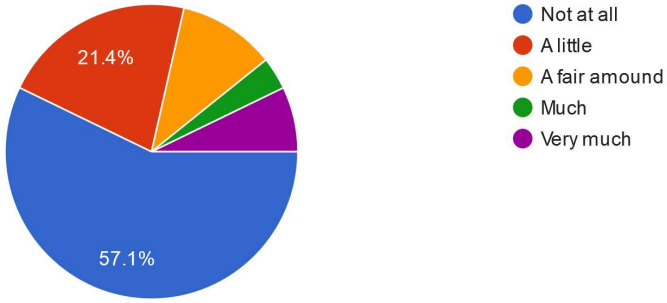
Being given a set of subtraction problems to solve

28 responses



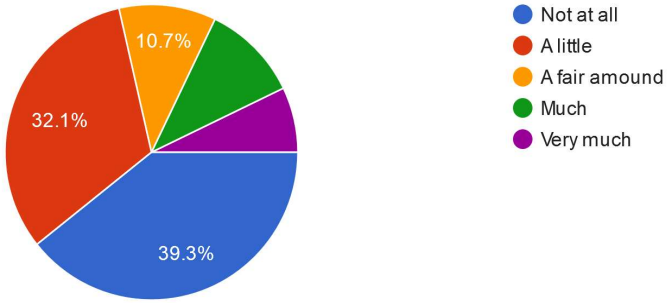
Being given a set of multiplication problems to solve

28 responses



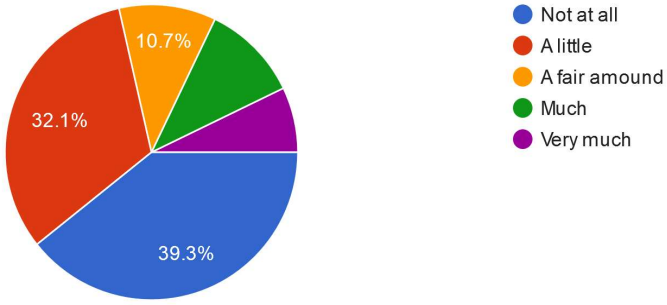
Being given a set of division problems to solve

28 responses



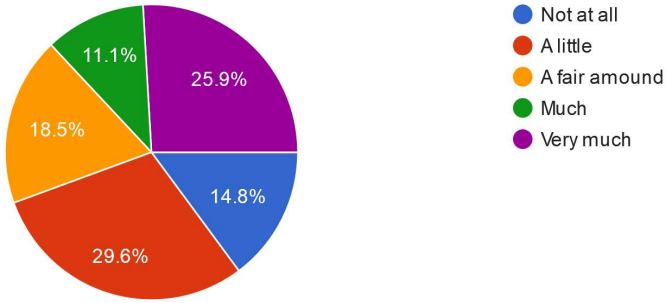
Watching a teacher work on an algebraic equation on a whiteboard

28 responses



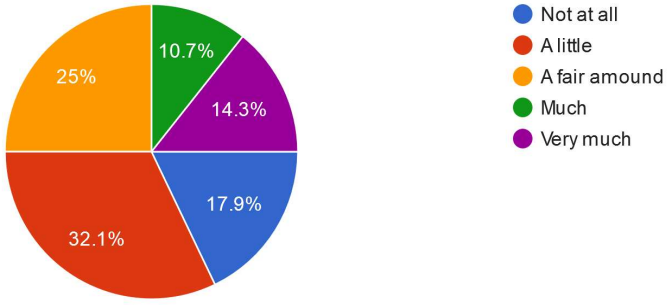
Signing up for a math course

27 responses



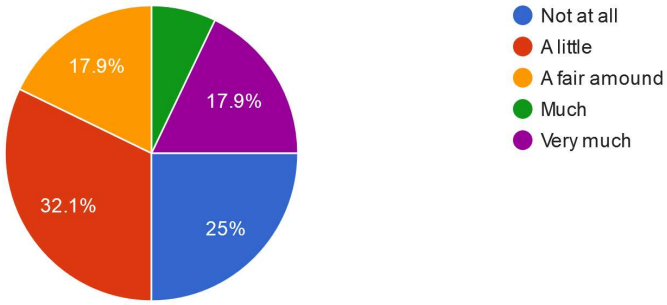
Listening to another student explain a math formula

28 responses



Walking into a math class

28 responses



A Guide to Mindful Journaling

Journaling will be an integral part of creating, reflecting, and sharing your mathematical journey! However, this process can be difficult, especially when we strive to write perfectly. Below are some key components of mindfulness that will help you be an effective journaler.

1. Observe your surroundings: Tune in to all of your senses to experience the sensations around you. Truly focus what is happening around you **without** trying to put what you experience into words. If you notice your mind trying to describe what is around you, acknowledge the thought, then refocus on your surroundings.

    Tip: Observe in a *one-mindful* fashion; this means focusing on one thing at a time. Having awareness of one activity in contrast to multitasking gives you the ability to experience the task with your whole self.

    Example: *Imagine you are in a coffee shop, and you want to tune into each sense one at a time. You see the bustle of people at the counter exchanging money, hear the steamers for espresso, smell the fresh baked bagels, taste the hot latte sitting next to you, and feel the heat resonating from the cup.*

2. Describe what you experience: This is a reaction to what you have observed. Focus on just the facts as you begin to label your experiences. If you find yourself struggling to describe your experiences, try setting a timer for two minutes and write down whatever pops in your mind. This is called a stream of consciousness exercise.

    Tip: Describing should be done *non-judgmentally*; focus on what has occurred, not what is good or bad. You can categorize what is helpful and what is harmful, but don't judge the scenario. If you catch yourself judging, don't judge yourself judging! Acknowledge your opinion, but then unglue it from the facts.

    Example: *The bustle of people is distracting and overwhelming in the front of the coffee shop, but the latte beside you has hints of cinnamon and pecan. The heat from the cup warms your hands as you take breaks between journaling. The freshness of the smell of bagels causes you to crave one with cream cheese.*

3. Participate: After describing what is happening around you, find a way to enter your surroundings. If you find yourself hesitant to jump right in, start with a small task and work your way up. You can also find a friend to participate with you.

    Tip: There is a difference between participating and participating *effectively*. Effective participation entails doing what needs to be done in each situation regardless of what is fair or unfair. It also involves acting skillfully in the environment you are in, not the environment you wish you were in.

Example: *To engage with the surroundings in the coffee shop, you decide to purchase the bagel you were craving. You wait in line, contemplating cream cheese flavors as you approach the counter. You interact with the cashier, notice their cheerful demeanor, and continue a conversation with them.*

Test Taking Strategies

Test Taking Strategies

- **Take each question one at a time-** Focus on the material of each question individually to not become overwhelmed by all material that is on the test.
- **Study Before the Test!-** Go into the test knowing what it will ask you and feeling confident in solving those problems. Practice the material beforehand. If you have any trouble with the material, save yourself the stress and get help before hand.
- **Get yourself in the zone and focus only on the problems**- Try to get rid of any distractions in your head. This will allow you to fully focus on the problems.
- **Remind yourself that one test, or one problem, does not define you**- Especially in PACe where you can retake any exam, remember that you are intelligent and wonderful *independent* of one exam score
- **If a concept is consistently difficult, focus on "why" not "how":** A bunch of steps that you know you should do but you don't know what order or what type of problem to use them for isn't helpful. Try to think about why each step makes sense, so you don't necessarily have to memorize "how" (although this usually happens during the process!)
- **Celebrate small victories:** Celebrate getting a problem finished! Try not to let the amount you haven't completed be your focus.
- **Take a breath (7-4-8):** If you feel the anxiety really building around the whole test or just one problem, take a small break to purposefully breath. Exhale deeply, breath in for 7 counts, hold for 4 counts breath out for 8 counts, repeat this twice and then take a final big exhale.
- **(For review exams) If your answer is wrong but you believe it is right**: Did you simplify the problem all the way? Reread the question carefully and verify what it is asking (for example is it asking for only the numerator or only the denominator)? Is there a way you can check your answer by working backwards?
- **(For proctored exams) Check your answer before you submit it**: Did you simplify the problem all the way? Reread the question carefully and verify what it is asking (for example is it asking for only the numerator or denominator)? Is there a way you can check your answer by working backwards (for example for factoring problems?
- Do all the questions you know first and then come back to the more difficult ones so you don't run out of time and can't do the ones you knew for sure.

PACe specific

- Know how to use PACe and course assistants
    - Mondays are busy but there is space in between deadlines, also 3pm is open
    - Don't come in last minute
    - Learn how to explain what you don't know
- Do review in PACe, then immediately take exams (keep notes from testing center to use for next time if didn't pass)

Time Saving Strategies

- **If you are working on a question for too long, skip it and come back to it later-** Working on a problem where you are no longer making any progress eats away at times. Skip it and come back to it later. You will have a different mind set when looking at the question again, allowing you to think about it differently in order to solve it. Usually other questions on the test can help you understand what you were not doing correct on your first attempt.
    - Related - Skip the problems that you don't know where to start and focus your first efforts on problems you know how to do, then go back and do the problems that you didn't know how to start. It is likely that your brain has warmed up to the test and these problems may not seem as tough now.
- **Use process of elimination-** When it comes to multiple choice problems, you are able to cancel out some of the answers based on what they tell you. Read the question, understand what it is telling you then look at all the answers. Figure out what is different between the answers and try to see what could be wrong. Use this mentality to guide how you go about solving the problem and you could turn a question that could have taken you 5 minutes to solve into a quick answer. Thinking smarter, not harder can save a large amount of time.
- **If you feel yourself not getting anywhere, submit it and try again!:** With PACe exams, you can take them as many times as you need. That being said, if you go in and realize you're not prepared/not in the right mindset, there's no need to stay in there for the remaining 38 minutes. Take a breath, submit your exam, and review it utilizing the "My Status" button on your own time.
- **Look at the answers first** to see what format your answer should be in.

The Guide to Taking PACe Courses

Spring 2020

Philosophy

This Guide is intended for students who are taking pre-calculus mathematics courses in Colorado State University's Paced Algebra to Calculus electronically (PAC*e*) Program.

Entry-level mathematics courses intended to prepare students to take other university courses that use mathematics are called pre-calculus courses. These courses include College Algebra, Logarithmic and Exponential Functions, and Trigonometry. At Colorado State, all pre-calculus courses are taught in the PAC*e* Program.

Students who take pre-calculus mathematics are an academically diverse group. They have different backgrounds, aptitudes, attitudes, and goals. In the early 1970's the CSU Mathematics Department became convinced that these students were not well served in traditional classrooms where, in spite of these differences, everyone is expected to learn in similar ways and at similar rates. This led to the development of the PAC*e* Program.

Since its inception, the management and development of the PAC*e* Program has been guided by the beliefs that college students must take the responsibility and initiative for their own learning and that given suitable learning resources, adequate time, and sufficient positive encouragement all college students can master entry level mathematics. The instructional design of these courses is based on a mastery program, meaning that students will achieve a minimum level of proficiently with each topic before proceeding to the next.

In the past forty-four years, the PAC*e* Program has developed into a flexible instructional system that gives all CSU students the opportunity to master pre-calculus mathematics by providing them choices of content, an array of learning resources, variability in credits and deadlines, and various levels of individual support and encouragement. In 1996 the university recognized the quality of the Individualized Mathematics Program (the former name of the PAC*e* Program) by awarding Dr. Klopfenstein, one of its long-time directors, the N. Preston Davis Award for Instructional Innovation.

The next evolution of the PAC*e* Program was launched Fall Semester of 2005 with fully online instructional material and the ability for students to work on their PAC*e* courses nearly 24x7. The College of Natural Sciences awarded Dr. Paul Kennedy, a former director of the PAC*e* Program, the 2007 Excellence in Teaching Award for Teaching Innovation in recognition of the design and development of this online instructional platform. In 2008, Dr. Kennedy was honored by being selected as a University Distinguished Teaching Scholar.

This Guide provides students in the PAC*e* Program with the information they need to organize and manage their learning experiences.

Contents

General Information

Location

The PAC*e* Center is located on the first floor in the Weber Building.

Inside the PAC*e* Center:

Learning Center	Weber 136
Resource Desk	Weber 136
Classroom	Weber 136A
Office	Weber 137
Testing Center	Weber 138

Hours

The **PAC*e* Center** is open* from January 21st to May 8th.

Day hours	Monday-Friday	9:00am-4:00pm
Evening hours	Monday-Thursday	6:30pm-9:00pm

*The PAC*e* center will be closed March 16th – 20th and any other time the University is closed.

The **PAC*e* website** is active 24x7** from January 21st to May 8th.

A maintenance window is reserved from **6:00am - 9:00am daily. If you use the system during this time, you do so at your own risk. The system may be taken offline without warning during this window to perform system maintenance.

PACe Professional Staff

Prof. Steve Benoit, Co-Director
Ms. Anita Pattison, Associate Director

Contact Information

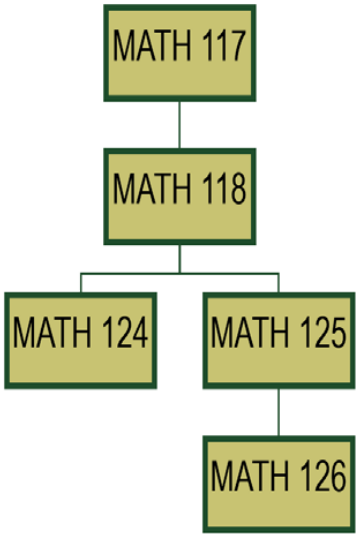
PAC*e* Director: 137 Weber Building (during PAC*e* hours)
E-mail: PAC*e*@math.colostate.edu
Phone: (970) 491-5761

To comply with Federal privacy laws, we cannot give out personal information over the phone. You must either:

- meet with a director and bring your RamCard, or
- send an email from your CSU email including your full name and CSU ID number.

PAC*e* Courses

Each PAC*e* course is one-credit. Below are the appropriate syllabi (including gtPathways-specific information), for each of the five courses, as well as the course prerequisite.



MATH 117: College Algebra in Context I,
Prerequisite: (1)
www.math.colostate.edu/syllabi/MATH117Syllabus.pdf

MATH 118: College Algebra in Context II,
Prerequisite: MATH 117 or (2)
www.math.colostate.edu/syllabi/MATH118Syllabus.pdf

MATH 124: Logarithmic and Exponential Functions,
Prerequisite: MATH 118 or (2)
www.math.colostate.edu/syllabi/MATH124Syllabus.pdf

MATH 125: Numerical Trigonometry,
Prerequisite: MATH 118 or (2)
www.math.colostate.edu/syllabi/MATH125Syllabus.pdf

MATH 126: Analytic Trigonometry,
Prerequisite: MATH 125 or (2) www.math.colostate.edu/syllabi/MATH126Syllabus.pdf

(1) To register for MATH 117, you must satisfy *one* of the following:

- earn an appropriate score on the **MPE** (Colorado State University Math Placement or Challenge Exam) or the ELM (Entry Level Mathematics) Exam.
- complete MATH 055, MATH 093, or MAT 099, with a C- or higher at a Colorado Community College.

(2) To register for MATH 118 or higher, you must satisfy *one* of the following:

- an appropriate placement on the **MPE**.
- satisfactorily completing the prerequisite course(s) at Colorado State.
- transfer credit for course(s) from another college or university.

You may take as many as five PAC*e* courses in a semester as long as the prerequisite for each course is satisfied or included in the package for which you are registering. Use RAMweb to register for PAC*e* courses. You must register for all PAC*e* courses you plan to take during the semester by the add deadline. The add, drop, and withdrawal period deadlines for the PAC*e* courses are given in Appendix IV.

Notice that being allowed to register for a course does not imply that you are eligible to take the course. If you are unable to access the online course materials because of a prerequisite problem, come to the PAC*e* Office where the staff will work with you to determine whether and how you satisfied the course prerequisite.

Weekly Expectations and Due Dates

The University expects students to be spending approximately three hours per week per credit on their courses (page 2 of the "Advising and Registration" section of the General Catalog). You have the flexibility to arrange which hours each week you want to schedule to complete your math.

All PAC*e* students are responsible for completing the required coursework on time. Use the table in Appendix II or III to find the due dates for your coursework based on the number of PAC*e* courses in which you are registered. To recover from missed due dates, you may reduce the number of PAC*e* courses in which you are enrolled to get a new set of due dates and potentially recover lost points. Speak with a PAC*e* Director if you have any questions or concerns.

Learning Resources in the PACe Program

Below is a list of resources available to help you succeed in the PAC*e* Program.

e-*text*

- Contains the course objectives for each unit and provides printable PDF files of lecture notes.
- You will have automatic access to the e-text without purchasing a physical copy or access code from the CSU Bookstore. Once the drop date passes (see Appendix IV), the CSU Bookstore will charge your account the cost of the e-text.
- The e-text grants access to all registered PACe courses for that semester. Following semesters will require additional purchases; however, you will retain access to the e-text for any courses you complete.

Video Lectures

- Lectures present a single objective at a time.
- Can be viewed multiple times and can be paused to allow you to take notes.
- "Try This" problems: You should try to solve these problems on your own and then check your solution by watching the video solution.

Learning Center

- Staffed with undergraduate course assistants trained to help you learn the PAC*e* content who provide walk-in tutoring **45 hours a week!**
- Raise your hand or walk up to a course assistant to initiate a conversation.
- Do not expect a course assistant to just give you answers, they will expect you to have done your part by studying the online materials and making a serious effort to understand and solve problems.
- You should spend *an hour or more* there studying math several times each week.

Solutions

- For every exam taken, you will be able to review the exam and see a solution to each problem. Access each exam taken via the "My Status" link.
- Keep organized scratch work when you take an exam. *It is helpful for you to have your scratch work as you review the exam solutions and when you have a need to discuss a problem with a course assistant.*

Resource Desk

Calculators

- Texas Instruments TI-83® or TI-84® Graphing Calculators are needed for all PAC*e* courses.
- Able to be checked out from the PAC*e* Resource Desk with your RamCard.
- These calculators may **ONLY** be used in the PAC*e* Center.
- Calculator manuals maybe checked out for daily use.
- Texas Instruments offers a free 90 day trail of their TI-84 emulating software: http://education.ti.com/en/us/products/computer_software/ti-smartview-software/ti-smartview-emulator-software-for-the-ti-84-plus-family/tabs/overview
- Texas Instruments also maintains a listing of TI-83/84 tutorial websites: http://education.ti.com/en/us/customer-support/training_online_tutorials/graphing-calculators

Textbooks

- May be checked out for a two-week period with your RamCard.

Headphones

- May be checked to be used **ONLY** in the PAC*e* center with your RamCard.

Longboards/Skateboards/Scooters

- Can be stored at the Resource desk.

Padlocks

- May be checked out for daily use to secure your belongings in a locker when you need to take a proctored exam.

Supplemental Websites

- Khan Academy is a free resource. It may require you to set up an account.
- Purple Math has many lessons for free. However, Purple Math Plus requires you to enroll in monthly or yearly plan.
- S.O.S. Mathematics is a free resource.
- West Texas A & M University Virtual Math Lab is a free online tutorial.

Course Procedures and Organization

User's Exam

The user's exam tests students about policies, procedures, and the instructional resources of the PAC*e* program. This guide contains all the information needed.

Setting	Number of Questions	Minimum Score to Pass	Number of Attempts	Passing Unlocks…
Available both as an Unproctored and Proctored Exam	20	16	Unlimited	Skills Review Exam

Skills Review

The skills review exam contains basic mathematical skills necessary for successful completion of the course. After the first attempt, videos to help you brush up on your mathematical skills are unlocked.

Setting	Number of Questions	Minimum Score to Pass	Number of Attempts	Passing Unlocks…
Unproctored	10	8	Unlimited	Learning Objective 1.1

Learning Objectives

Each unit has five learning objectives. There is an overview video to introduce the topic being studied. The sub-objectives have many example videos to help gain a fuller understanding of the topic. You can attempt the "Try This" problems on your own, then look at the video for a solution. At the end of the learning material for the objective, you will find the link to the Required Assignment.

Required Assignments

There is a required assignment for each learning objective. These assignments help solidify your knowledge of the content from the video lectures. You can complete these assignments multiple times for extra practice.

Setting	Number of Questions	Minimum Score to Pass	Number of Attempts	Passing Unlocks…
Unproctored	3	3	Unlimited	Next Learning Objective

Review Exams

There are four review exams per PAC*e* course. In order to gain access, you must have completed the required assignment for that unit AND passed the previous unit's proctored exam. If the review exam is completed by the deadline, you will earn 3 points; else, you will earn no points (see Grading on page 10). A good way to study for the final is by retaking the review exams.

Setting	Number of Questions	Minimum Score to Pass	Number of Attempts	Passing Unlocks…
Unproctored	10	8	Unlimited	Current Unit Exam

Unit Exams

There are four unit exams per PAC*e* course. You are eligible to take the unit exam once the review exam for that unit is passed. You can take the unit exam an unlimited number of times; however, every two times you do not pass you must repass that unit's review exam. Once the unit exam is passed, you can take it an unlimited amount of times until the due date for the final exam. If you have passed the final exam, you may retest until the last day of classes for the current semester. Only your best passing score will count toward your grade (see Grading on page 10).

Setting	Number of Questions	Minimum Score to Pass	Number of Attempts	Passing Unlocks…
Proctored (40 minute time limit)	10	8	2 non-passing attempts at a time, unlimited once you pass	Next Unit's Review Exam or the Final Exam

Final Exam

The final exam is cumulative and is only unlocked after the unit 4 exam is passed. You have unlimited attempts to take the final exam until the PAC*e* Center closes on the due date. If you have passed the unit 4 exam but have not passed the final by the date it is due, you will be allowed one* attempt the next day the PAC*e* Center is open.

Setting	Number of Questions	Minimum Score to Pass	Number of Attempts	Passing Unlocks…
Proctored (75 minute time limit)	20	16	Unlimited	Next PAC*e* course (if you have at least 57 points in the course, retest as needed)

* If you qualified for the Testing Center Bonus (see Testing Center Bonus on page 9) you will have a total of two extra attempts on the Final Exam for your **first** PAC*e* course.

"My Status"

At any time, if you wish to review the exams you have taken during the semester, click the "My Status" link on the sidebar. This page includes:

- A current point total for the course and the course grading scale.
- the number of unit exams attempts available.
- A copy of exam attempt with your answers and the solutions.
- Best scores on the unit and final exams.

Retesting

There are no restrictions on the number of times you may take an exam. Regardless of how many times you take an exam, only your best passing score will count toward your final grade.

You may retest in any previously passed unit of any PACe course until the due date for the Final Exam for that course. If you have passed the Final Exam, you may continue retesting until the last day of classes for the current semester. You may need to retest to earn enough points to complete the course and/or you may wish to retest to improve your grade.

If you are taking several PACe courses, you may retake exams from an earlier course even though you have gone on to another course. For example, if you finished your first PACe course but only earned a "C" grade, you may proceed to another PACe course and at the same time continue to work on the first one to earn a higher grade.

Course Completion

In addition to passing the four unit exams and the final exam with a score of at least an 80% on each exam, you must earn 57 points or higher to complete the course (see Grading on page 10).

Testing

The Testing Center (Weber 138) has the same walk-in hours as the PAC*e* center (see General Information on page 3) with the following notes:

- Testing Center doors close 15 minutes before closing time, and no new exams may be started.
- All exams **MUST** be submitted by closing time.

Mechanics of Taking an Exam in the Testing Center

1. Bring your RamCard and a pen or pencil to Testing. *All other items must be stored in a* PAC*e locker.* Note a calculator and scratch paper is provided.
    - Writing on the hand, cell phones, and other personal electronic devices will be viewed as reference material, which is prohibited in Testing
2. A staff member will assign you to a computer and give you scratch paper
3. Place your RamCard (with your picture facing up) at the computer. Enter your CSU ID number to begin the exam.
4. Acknowledge the CSU Honor Pledge. Your exam and a calculator will show up on screen.
5. The computer will display how much time you have left. Your exam will automatically submit once time runs out.
6. Once finished, take your belongings and check out with a PAC*e* staff member. *Be sure to keep your scratch work!*
7. Check your results via "My Status", and use your scratch paper to go over missed problems with a course assistant.

If at any point you need assistance, raise your hand and a proctor will come help you.

Testing Center Bonus

How to earn the bonus: You should visit the PAC*e* Center the first week of the semester to become familiar with the resources available. To encourage you to experience the Testing Center, you can earn a bonus by taking an exam in the PAC*e* Testing Center during the first week of the semester. You do not have to achieve a passing score to earn the bonus. The following types of exams will count toward the Testing Center Bonus: Math Challenge, ELM, User's, Unit, and Final Exams. You can only earn one bonus.

What is the bonus: If you are eligible to take the Final Exam for your **first** PAC*e* course by the due date listed and have not yet passed it, the Testing Center Bonus gives you an extra attempt (for a total of two) on the Final Exam the very next day the PAC*e* Center is open.

Grading

There are 72 total points possible in each course. The final grade is determined by the sum of your best scores for each of the four Unit Exams and the Final Exam, plus any points earned from passing the Review Exams by the applicable due date. The table below shows the breakdown of how you can earn points:

Exam Type	Number of Exams	Points Possible for Each Exam	Total Number of Points Possible
Review Exam	4	0 or 3	0 to 12
Unit Exams	4	8 to 10	32 to 40
Final Exam	1	16 to 20	16 to 20

When you have completed your courses, MATH 117, MATH 118, MATH 124, MATH 125, or MATH 126, by passing all four Unit Exams, in order, and the Final Exam with best scores of 80% or better, you are assigned a grade of A, B, C, or U, according to the following table:

Total Points	Grade
65 to 72	A
62 to 64	B
57 to 61	C
Not completed (< 57)	U

If you have not completed a PAC*e* course for which you are registered, you are assigned a grade of U (unsatisfactory). The U grade is a permanent transcript entry, but does not affect the CSU grade point average. However, some universities and financial aid agencies treat the U grade as an F when evaluating student records for graduate or transfer admissions or for awarding financial aid. To earn credit for a course in which a U grade was assigned, you would need to register for the course again and satisfactorily complete it from the beginning.

A grade of F is assigned in special circumstances involving academic misconduct.

An I (incomplete) may be assigned if you have worked responsibly and consistently on a course during the semester, *but circumstances that were beyond your control and could not have reasonably have been anticipated prevented completion of the course*. If you believe you qualify for an incomplete on this basis you should discuss your situation with a Director in the PAC*e* Office.

Questions and appeals concerning grades should first be directed to one of the PAC*e* Directors in the PAC*e* Office (Weber 137). If differences cannot be satisfactorily resolved with a PAC*e* Director, further appeals may be pursued in accordance with the policies on Grading and Grade Appeals under "Advising and Registration" in the *General Catalog*.

Disabilities

Colorado State University is committed to providing reasonable accommodations for all persons with disabilities. Students with disabilities who need accommodations must first contact the Student Disability Center before requesting accommodations for their PAC*e* course(s). The Student Disability

Center is located in room 121 of the TILT Building. Their phone is (970) 491-6385 (V/TDD). Students who need accommodations must speak with a PAC*e* Director in a timely manner to discuss needed accommodations.

Academic Misconduct

Academic misconduct undermines the educational experience at Colorado State University, lowers morale by engendering a skeptical attitude about the quality of education, and negatively affects the relationship between students and faculty/instructors.

Faculty/Instructors are expected to use reasonably practical means of preventing and detecting academic misconduct. Any student found responsible for having engaged in academic misconduct will be subject to academic penalty and/or University disciplinary action.

Students are encouraged to positively impact the academic integrity culture of the University by reporting incidents of academic misconduct. (See the General Catalog.)

Possession of visually, audibly, or tactilely accessible materials in the PAC*e* Testing Center that could assist the student in earning a higher score on an examination and attempting to misrepresent information are examples of academic misconduct.

The University Policy on Academic Integrity is vigorously enforced in the PAC*e* Program. Students judged to have engaged in academic misconduct may be assigned a reduced grade or a grade of F for the course and/or other penalties may be imposed. All incidents of academic misconduct will be reported to Conflict Resolution and Student Conduct Services for possible further disciplinary action. Incidents of impersonation may be referred to the University Police for criminal investigation.

Any evidence that a student is engaging or has engaged in an act of academic misconduct will be reported to a Director of the PAC*e* Program. The Director will give the student involved the opportunity to provide his/her explanation of the incident. If the student admits to engaging in academic misconduct or if the Director judges that a preponderance of evidence exists to support the allegation of academic misconduct, the Director may impose an academic penalty and will report the incident to Conflict Resolution and Student Conduct Service.

If the student disputes the allegation of academic misconduct, he/she should request a hearing with the Conflict Resolution and Student Conduct Service. The University Hearing Officer will determine whether or not a preponderance of evidence exists in support of the allegation of academic misconduct. If the University Hearing Officer finds insufficient evidence or clears the student of charges, the penalty imposed by the PAC*e* Director will be rescinded and the student's previous status in the PAC*e* Program restored. If the University Hearing Officer finds the student culpable, the Hearing Officer may impose additional University disciplinary sanctions. For further information see "Students' Responsibilities" under "Policies and Guiding Principles" in the *General Catalog*.

Appendix I: Sample User's Exam

1. Which of the following are true about the Testing Center Bonus?
   There is at least one correct response. Choose all correct responses.
   a. You must pass an exam in the PAC*e* Testing Center during the first week of classes to earn the Testing Center Bonus.
   b. It is to your advantage to earn the Testing Center Bonus.
   c. If you are eligible to take the Final Exam for your first course on the due date listed, and have not yet passed it, the Testing Center Bonus gives you an additional attempt on the Final Exam.
   d. By taking an exam in the PAC*e* Testing Center during the first week of classes, you will earn the Testing Center Bonus.

2. Which two of the following are true about the last day to add and withdraw from PAC*e* courses this semester?
   a. You may add PAC*e* courses at any time during the semester.
   b. You may add PAC*e* courses until the add period ends which occurs at the end of the first week of classes.
   c. You may withdraw from PAC*e* courses at any time during the semester.
   d. You may withdraw from PAC*e* courses until the withdrawal period ends which occurs at the end of the 12th week of classes.

3. Imagine you are registered for 2 of the one credit PAC*e* courses this semester. Based on University expectations, how many hours should you spend each week working on completing these 2 courses?
   a. 1
   b. 2
   c. 4
   d. 6
   e. 8

4. In order to practice your problem solving skills, every course in the PAC*e* Program has Required Assignments. Which of the following are true about Required Assignments?
   There is at least one correct response. Choose all correct responses.
   a. Required Assignments must be completed in the PAC*e* facilities.
   b. You must answer three problems correctly to complete the Required Assignment.
   c. Every unit has five Required Assignments.
   d. Required Assignments can be completed multiple times for additional practice.

5. Which of the following are true about office hours offered by the PAC*e* Program?
   There is at least one correct response. Choose all correct responses.
   a. Course assistants will expect you to have done some preparation before working with you.
   b. Course assistants will give you a private lecture.
   c. Tutoring is available on a walk-in basis.
   d. There is no fee for tutoring.
   e. You should plan to spend at least 20 minutes per week per PAC*e* course meeting with a course assistant.

6. Which of the following statements are true regarding Review Exams?
   There is at least one correct response. Choose all correct responses.
   a. An appropriate way to study for the Final Exam is to retake the four unit Review Exams.
   b. Before you can take the Unit 2 Review Exam, you must pass both the Unit 1 Review and Unit Exams.
   c. If you pass the unit Review Exam for the first time by the due date, you will receive 3 points.
   d. If you do not pass a Unit Exam after two attempts, you must pass the Review Exam again to earn two additional attempts on the Unit Exam.

7. Which of the following must be completed before you may take the Unit 2 Review Exam?
   There is at least one correct response. Choose all correct responses.
   a. You must have attempted, but may have not yet passed, the Unit 1 Exam.
   b. You must have passed the proctored Unit 1 Exam.
   c. You must have passed the Unit 1 Review Exam.
   d. You must have completed all five of the Unit 2 Required Assignments.

8. Reference materials of any kind are not allowed in the PAC*e* Testing Center. Which <u>two</u> of the following items are you allowed to bring into the PAC*e* Testing Center?
   a. a pencil or pen
   b. your calculator
   c. your RamCard (CSU Student ID card)
   d. study material written on your hand
   e. a cell phone

9. Which of the following must be completed before you may take a Unit 3 Exam?
   There is at least one correct response. Choose <u>all</u> correct responses.
   a. You must have completed all five of the Unit 3 Required Assignments.
   b. You have attempted, but not yet passed the Unit 2 Exam.
   c. You must have passed the Unit 3 Review Exam.
   d. You have passed the Unit 2 Exam.

10. Which of the following are learning resources offered by the PAC*e* Program?
    There is at least one correct response. Choose <u>all</u> correct responses.
    a. online video lectures
    b. solutions to exam problems
    c. free, "walk-in" tutoring (Office Hours)
    d. a Resource Desk, where supplemental texts and calculators can be checked out

11. Which <u>two</u> of the following are options if you do not pass the Final Exam by the due date?
    a. If you are eligible to take the Final Exam by the due date listed and have not yet passed it, you will be allowed one attempt on the Final Exam the next day the PACe Center is open.
    b. You can keep trying to pass the Final Exam until the end of the semester.
    c. You may reduce the number of courses in which you are enrolled to get a new set of due dates and have more time to pass the Final Exam.

12. Imagine you just took the Unit 3 Exam in a PAC*e* course for the second time. Via the "My Status" link, you learned that you did NOT earn a passing score on either of your two attempts. Which of the following can you do?
There is at least one correct response. Choose all correct responses.
    a. Go back into the Testing Center and take the Unit 1 Exam to improve a previous score.
    b. Retake and pass the Unit 3 Review Exam and then take the Unit 3 Exam again.
    c. Go back into the Testing Center and take the Unit 3 Exam again.
    d. Go back into the Testing Center and take a Unit 4 Exam.
    e. Start working on the Unit 4 Required Assignments.

13. Imagine you just took the Final Exam in a PAC*e* course for the second time. Via the "My Status" link, you learned that you did NOT earn a passing score on either of your two attempts. Which of the following can you do?
There is at least one correct response. Choose all correct responses.
    a. Add your highest Final Exam score to your point total to see if you have earned at least 57 points.
    b. You **must** repass all four of the unit Review Exams to be able to take the Final Exam two more times.
    c. Retake the 4 unit reviews exams to study more.
    d. Keep retaking the Final Exam an unlimited number of times until the PACe Center closes on your due date.

14. Which of the following are characteristics of the course due dates for PAC*e* courses?
There is at least one correct response. Choose all correct responses.
    a. You cannot take a Review Exam after the due date for that exam.
    b. The first time you pass a Review Exam before its due date, you will receive 3 points.
    c. The Final Exam must be passed before the PACe Testing Center closes on the due date listed.
    d. If you are eligible to take the Final Exam by the due date listed and have not yet passed it, you will be allowed one attempt on the Final Exam the very next day the PACe Center is open.
    e. If you do not pass a Review Exam by its due date, you will receive zero points for the Review Exam but will still need to pass it to move on with the course material.

15. You just passed the Final Exam for your PAC*e* course. You check the "My Status" link and see that you have a total of 55 points in the course. Which of the following are true?
There is at least one correct response. Choose all correct responses.
    a. You can keep retesting to improve your grade **until** the due date for your Final Exam.
    b. You can keep retesting to improve your grade **after** the due date for your Final Exam.
    c. You cannot retest.
    d. You must keep retesting to earn at least 57 point to pass the course.
    e. You cannot start your next PAC*e* course until you have at least 57 point in your current course.

16. What happens if you do **NOT** pass a Review Exam by the due date?
There is at least one correct response. Choose <u>all</u> correct responses.
    a. You will lose three of the 72 points possible for the course.
    b. It is still possible to get an A in the course if you only miss one Review Exam due date.
    c. You cannot pass the course if you miss all four Review Exam due dates.
    d. (Re)take the Review Exam until you do pass it.
    e. You can get help from the Course Assistants in the PAC*e* Learning Center.

17. The current point total for your PAC*e* course is available via the "My Status" link. Which of the following scores are included in your point total?
There is at least one correct response. Choose <u>all</u> correct responses.
    a. Your best Final Exam score.
    b. Your best Final Exam score, if it is at least 80%.
    c. Your best passing Unit Exam scores.
    d. Your best Unit Exam scores.
    e. Points earned by passing a Review Exam for the first time by the due date for that exam.

18. Which of the following are available from the online course materials "My Status" link?
There is at least one correct response. Choose all correct responses.
    a. the course grading scale
    b. results of your Review, Unit, and Final Exams
    c. the number of Unit Exam attempts you have available
    d. your current point total for the course

19. What must you do to earn credit for a PAC*e* course?
There is at least one correct response. Choose <u>all</u> correct responses.
    a. You must achieve a minimum passing score (70%) on each of the Unit Exams for the course.
    b. You must achieve a minimum passing score (80%) on each of the Unit Exams for the course.
    c. You must achieve a minimum passing score (70%) on the Final Exam for the course.
    d. You must achieve a minimum passing score (80%) on the Final Exam for the course.
    e. You must earn a minimum number of points.

20. The grade of U does not affect a student's grade-point average at CSU. Which <u>two</u> of the following are also true when you are assigned a grade of U (Unsatisfactory) for a PAC*e* course?
    a. The U is a permanent entry on your transcript.
    b. The U will be removed from your transcript if you finish the course in a future semester.
    c. You can continue with the course the next semester and have all of your unit exam scores carry over from the semester the U was assigned.
    d. In order to receive credit for the course, you must register for the course again and complete it from the beginning.

Appendix II: Exam Dues Dates, Enrollment in One or Two Courses, Spring 2020

All PAC*e* students are responsible for completing the required coursework on time. Use this table to determine the due dates for your coursework if you are enrolled in one or two PAC*e* Courses. Follow the column that represents how many PAC*e* courses you are registered for this semester.

	2 Courses	2 Courses	1 Course	1 Course
1st Course	**Track A[1]**	**Track B[2]**	**Track A[1]**	**Track B[2]**
1st Review Exam*	Fri., Jan. 31	Tues., Feb. 4	Thurs., Feb. 6	Mon., Feb. 10
2nd Review Exam	Tues., Feb. 11	Thurs., Feb. 13	Tues., Feb. 25	Thurs., Feb. 27
3rd Review Exam	Thurs., Feb. 20	Mon., Feb. 24	Wed., Mar. 11	Fri., Mar. 13
4th Review Exam	Mon., Mar. 2	Wed., Mar. 4	Mon., Apr. 6	Wed., Apr. 8
Final Exam**	Fri., Mar. 6	Tues., Mar. 10	Mon., Apr. 20	Wed., Apr. 22
2nd Course				
1st Review Exam	Wed., Mar. 25	Fri., Mar. 27		
2nd Review Exam	Fri., Apr. 3	Tues., Apr. 7		
3rd Review Exam	Tues., Apr. 14	Thurs., Apr. 16		
4th Review Exam	Thurs., Apr. 23	Mon., Apr. 27		
Final Exam	Wed., Apr. 29	Fri., May 1		

[1] Follow the due dates listed for **Track A** if the first course you start is **MATH 117 or MATH 125.**
[2] Follow the due dates listed for **Track B** if the first course you start is **MATH 118, 124, or 126.**

*** Review Exam**

- If passed by midnight (MST) on the due date listed you will receive 3 points toward your final grade.
- If you do not pass a Review Exam by its due date, you will receive zero points for the Review Exam but will still need to pass it to move on with the course material.

Unit Exam

- There are no due dates for the Unit Exams. However, you must pass the Unit Exam, in the PACe Testing Center, before you are able to take the Review Exam for the next unit.
- You may retest on Unit Exams to improve your score until the Final Exam due date for that course.

**** Final Exam**

- Must be passed before the PAC*e* Testing Center closes on the due date listed.
- If you are eligible to take the Final Exam by the due date listed and have not yet passed it, you will be allowed one attempt on the Final Exam the next day the PAC*e* Center is open.
- If the Final Exam is passed, you may retest on any exam (Unit or Final) for that course until 4:00pm on May 8, 2020. You may need to retest to earn enough points to complete the course and/or you may wish to retest to improve your grade.
- If you do not pass the Final Exam**,** you may reduce the number of courses in which you are enrolled to get a new set of due dates and potentially recover lost points. Refer to Appendix IV for PAC*e* Registration Deadline Dates. Speak with a PAC*e* Director if you have any questions or concerns.

Appendix III: Exam Dues Dates, Enrollment in Three or More Courses, Spring 2020

All PAC*e* students are responsible for completing the required coursework on time. Use this table to determine the due dates for your coursework if you are enrolled in three or more PAC*e* Courses. Follow the column that represents how many PAC*e* courses you are registered for this semester.

	5 Courses	4 Courses	3 Courses
1st Course			
1st Review Exam*	Tues., Jan. 28	Wed., Jan. 29	Thurs., Jan. 30
2nd Review Exam	Fri., Jan. 31	Mon., Feb. 3	Wed., Feb. 5
3rd Review Exam	Wed., Feb. 5	Fri., Feb. 7	Wed., Feb. 12
4th Review Exam	Mon., Feb. 10	Thurs., Feb. 13	Tues., Feb. 18
Final Exam**	Wed., Feb. 12	Tues., Feb. 18	Fri., Feb. 21
2nd Course			
1st Review Exam	Mon., Feb. 17	Fri., Feb. 21	Fri., Feb. 28
2nd Review Exam	Thurs., Feb. 20	Wed., Feb. 26	Thurs., Mar. 5
3rd Review Exam	Tues., Feb. 25	Tues., Mar. 3	Thurs., Mar. 12
4th Review Exam	Fri., Feb. 28	Mon., Mar. 9	Thurs., Mar. 26
Final Exam	Tues., Mar. 3	Thurs., Mar. 12	Wed., Apr. 1
3rd Course			
1st Review Exam	Fri., Mar. 6	Tues., Mar. 24	Wed., Apr. 8
2nd Review Exam	Wed., Mar. 11	Fri., Mar. 27	Wed., Apr. 15
3rd Review Exam	Mon., Mar. 23	Thurs., Apr. 2	Tues., Apr. 21
4th Review Exam	Thurs., Mar. 26	Wed., Apr. 8	Tues., Apr. 28
Final Exam	Mon., Mar. 30	Mon., Apr. 13	Mon., May 4
4th Course			
1st Review Exam	Thurs., Apr. 2	Thurs., Apr. 16	
2nd Review Exam	Tues., Apr. 7	Tues., Apr. 21	
3rd Review Exam	Fri., Apr. 10	Mon., Apr. 27	
4th Review Exam	Wed., Apr. 15	Fri., May 1	
Final Exam	Fri., Apr. 17	Wed., May 6	
5th Course			
1st Review Exam	Wed., Apr. 22		
2nd Review Exam	Mon., Apr. 27		
3rd Review Exam	Thurs., Apr. 30		
4th Review Exam	Tues., May 5		
Final Exam	Thurs., May 7		

*** Review Exam**

- If passed by midnight (MST) on the due date listed you will receive 3 points toward your final grade.
- If you do not pass a Review Exam by its due date, you will receive zero points for the Review Exam but will still need to pass it to move on with the course material.

Unit Exam

- There are no due dates for the Unit Exams. However, you must pass the Unit Exam, in the PAC*e* Testing Center, before you are able to take the Review Exam for the next unit.
- You may retest on Unit Exams to improve your score until the Final Exam due date for that course.

**** Final Exam**

- Must be passed before the PAC*e* Testing Center closes on the due date listed.
- If you are eligible to take the Final Exam by the due date listed and have not yet passed it, you will be allowed one attempt on the Final Exam the next day the PAC*e* Center is open.
- If the Final Exam is passed, you may retest on any exam (Unit or Final) for that course until 4:00pm on May 8, 2020. You may need to retest to earn enough points to complete the course and/or you may wish to retest to improve your grade.
- If you do not pass the Final Exam**,** you may reduce the number of courses in which you are enrolled to get a new set of due dates and potentially recover lost points. Refer to Appendix V for PAC*e* Registration Deadline Dates. Speak with a PAC*e* Director if you have any questions or concerns.

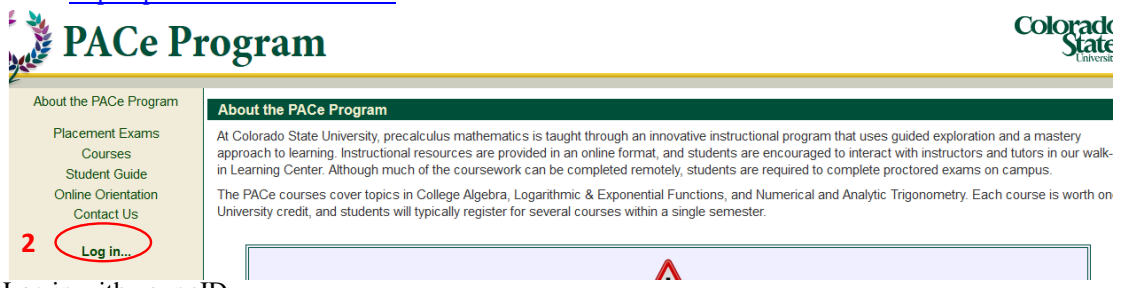
Appendix IV: Registration Deadline Dates, Spring 2020

Use the computer registration system (RAMweb) to Add, Drop or Withdraw from PAC*e* courses.

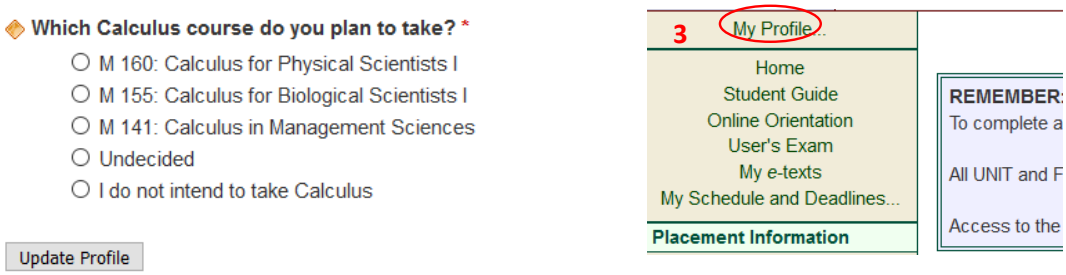
Course Add deadline: Section 001 of MATH 117, MATH 118, MATH 124, MATH 125, and MATH 126	Sunday, January 26th
Course Drop deadline: Section 001 of MATH 117, MATH 118, MATH 124, MATH 125, and MATH 126	Wednesday, February 5th
Course Withdrawal deadline: Section 001 of MATH 117, MATH 118, MATH 124, MATH 125, and MATH 126	Sunday, April 19th

Appendix V: PAC*e* Program Quick Start Guide

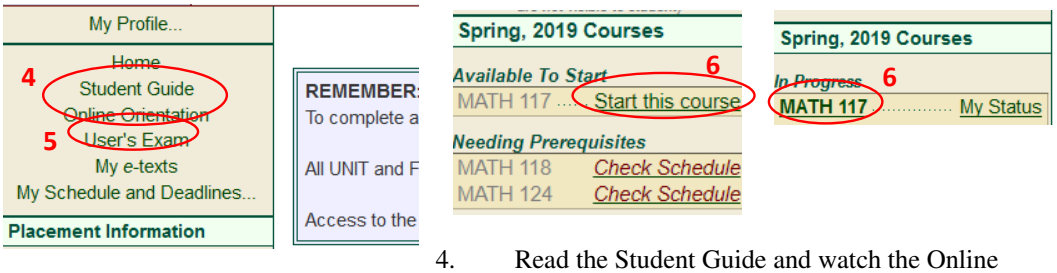
1. Go to https://pace.math.colostate.edu



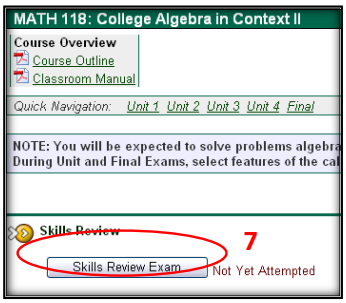
2. Log in with your eID.



3. Update your profile by answering the question "Which Calculus course do you plan to take?" This question should appear when you first log in but you can update by selecting "My Profile".

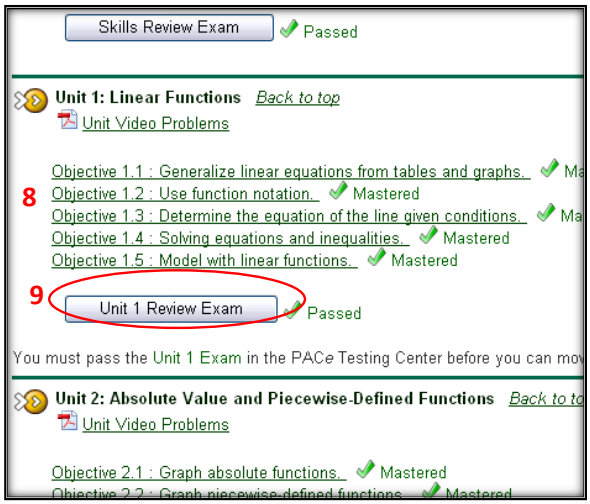


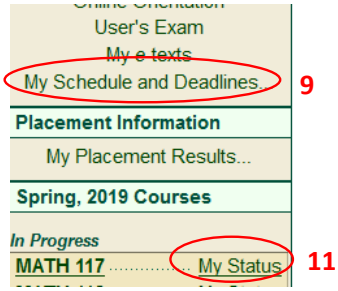
4. Read the Student Guide and watch the Online Orientation for more detailed and complete information.
5. Pass the User's Exam.
6. Click to start your course, and then click on the course (MATH 1XX).



7. Pass the Skills Review Exam.

8. Complete all five of Unit 1 Required Assignments. (You can continue on to the next unit if you wish.)
9. Pass the Unit 1 Review Exam by the due date (under "My Schedule and Deadlines").
10. Pass the Unit 1 Exam in the PACe Testing Center. (You must pass the Unit 1 Exam before you can take the Unit 2 Review Exam.)
11. Review the exams you have taken and your point total under the "My Status" link.





12. Repeat steps 8 – 11 for Units 2, 3, and 4.
13. Study for the Final Exam by practicing Unit Review Exams.
14. **Take the Final Exam as many times as needed** to earn a passing score before the PACe Testing Center closes on the due date.
15. If you have not passed the Final Exam by the due date, **and you have passed the Unit 4 Exam**, you have one more attempt to pass the Final Exam the next day the PACe Center is open after your due date.
16. Retest, if necessary, on any Unit and/or Final Exam to complete the course (must have at least 57 points in the course).
17. If you do not pass your Final Exam, you will need to adjust your registration to continue working on your math courses. Ask in the PACe Office, Weber 137, for your options.
18. Repeat steps 6 – 17 for your next PACe Course(s)
19. Retest on any Unit or Final Exam if you wish to improve your grade. You may retest on any course in which you have passed the Final Exam until the last day of classes for the semester.

Please note:

If you did not pass a Review Exam by its due date, **you have earned zero of three points possible**. You can still pass the course if you miss Review Exam due dates. But, you will need to gain back some of the missing points by scoring higher on the Unit and Final Exams.

Number of Review Exams passed by the due date.	Minimum number of points, out of 60 possible, you must earn on Unit and Final Exams to receive the following grade.		
	A	B	C
4	53	50	48
3	56	53	48
2	59	56	51
1	Not possible	59	54
0	Not Possible	Not Possible	57