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### Community College Developmental Mathematics Classrooms: Understanding Supportive Faculty Strategies and Impact on Student Success

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# Community College Developmental Mathematics Classrooms: Understanding Supportive Faculty Strategies and Impact on Student Success

## Abstract

The purpose of this quantitative study was to explore supportive faculty strategies as described by students and faculty of developmental mathematics courses at two community colleges in Upstate New York. Using validation theory, the study focused on compiling information from students and faculty regarding the importance of supportive factors inside and outside of the developmental mathematics classrooms. Data were collected from surveys administered in the spring 2016 semester, and analyses of these data led to several findings: (a) students significantly rated faculty lower than faculty self-reported on caring instruction; (b) there was a weak, positive correlation that showed the longer an instructor had been teaching and the greater the course load assigned; the higher the ratings for caring instruction and appreciation for diversity; (c) the four subconstructs as a whole significantly predicted student sense of belonging, persistence, and competence; (d) students and faculty agree there must be improved supports to help students perform better on math placement testing; (e) faculty is not a main source of information for middle-skill opportunities; and (f) students are generally unaware of STEM opportunities. There were two recommendations for future research: to conduct a quantitative study which allows for the collection and analysis of paired student and faculty data, and to conduct a qualitative study aimed at examining each subconstruct from the individual perspective of student and of faculty. The recommendations for higher education were to (a) provide professional development for faculty and staff aimed at understanding how to create a supportive environment for students, (b) provide review sessions prior to math placement testing, and (c) establish informational workshops designed to facilitate student and faculty collaboration while providing education on STEM and middle-skill opportunities.

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Community College Developmental Mathematics Classrooms:  
Understanding Supportive Faculty Strategies and Impact on Student Success

By

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of the requirements for the degree  
Ed.D. in Executive Leadership

Supervised by

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Committee Member

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Ralph C. Wilson, Jr. School of Education

St. John Fisher College

December 2016

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## **Dedication**

First, I would like to thank my committee, Dr. Marie Cianca and Dr. Caroline Critchlow, for struggling through this creative process with me and supporting me towards completion of my degree. Next, I need to thank my friends for taking me out when I was completely drained and for shaking off the fatigue and stress. My best friends Joe, Linjung, Diane, and Matt all went out of their way to help me maintain stability and, most of all, sanity. Most importantly, I need to thank my family for their unconditional support and constant encouragement. There were more than a thousand instances where I felt like my brain couldn't manage any more stimuli than what was already thrown at it day after day. My siblings, Mike, Laura, and Anthony, made me realize that I am more than capable of achieving my dreams and to never stop working hard to make becoming the first doctor in our family a reality. Finally, I want to thank my niece Alena and little sister Arielle for being the little creatures who look up to me, who keep me accountable in all that I do, and who analyze my adventurous path knowing that it means they too can accomplish anything they dream.

## **Biographical Sketch**

Rachel Santiago began her teaching career in 2007 working at a high school as a Geometry teacher, then earned a position as a mathematics adjunct instructor at a community college. Throughout this time, she was also working as a GED instructor for a local city school district, and then helped to establish and successfully implement a GED program for probationers through a not-for-profit organization in conjunction with the county probation office. In 2013, she was promoted at the community college from adjunct status to full-time status and continues to serve in this capacity.

Ms. Santiago attended the Rochester Institute of Technology from 2002-2007 and graduated with a Bachelor of Sciences degree in Applied Mathematics with a minor in Psychology. She then continued her education at RIT from 2010-2013 and graduated with a Master of Sciences degree in Applied Mathematics with a concentration in Dynamical Systems. She came to St. John Fisher College in the fall of 2014 and began doctoral studies in the Ed.D. Program in Executive Leadership. Ms. Santiago pursued her research in supportive faculty behaviors in community college developmental mathematics courses under the direction of Dr. Marie Cianca and Dr. Caroline Critchlow and received the Ed.D. degree in 2016.

## Abstract

The purpose of this quantitative study was to explore supportive faculty strategies as described by students and faculty of developmental mathematics courses at two community colleges in Upstate New York. Using validation theory, the study focused on compiling information from students and faculty regarding the importance of supportive factors inside and outside of the developmental mathematics classrooms. Data were collected from surveys administered in the spring 2016 semester, and analyses of these data led to several findings: (a) students significantly rated faculty lower than faculty self-reported on *caring instruction*; (b) there was a weak, positive correlation that showed the longer an instructor had been teaching and the greater the course load assigned; the higher the ratings for *caring instruction* and *appreciation for diversity*; (c) the four subconstructs as a whole significantly predicted student *sense of belonging*, *persistence*, and *competence*; (d) students and faculty agree there must be improved supports to help students perform better on math placement testing; (e) faculty is not a main source of information for middle-skill opportunities; and (f) students are generally unaware of STEM opportunities. There were two recommendations for future research: to conduct a quantitative study which allows for the collection and analysis of paired student and faculty data, and to conduct a qualitative study aimed at examining each subconstruct from the individual perspective of student and of faculty. The recommendations for higher education were to (a) provide professional development for faculty and staff aimed at understanding how to create a supportive environment for students, (b) provide review

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## **Chapter 1: Introduction**

### **Developmental Instruction in Community Colleges**

Community colleges across the nation serve as a means for students to have open access to higher education and to have access to classes that are less expensive than their 4-year counterparts. However, most students entering community colleges are not ready for college-level work (Bautsch, 2013; Jaggars, Hodara, Cho, & Xu, 2015). As many as 60% of community college students enroll in developmental courses (Melguizo, Kosiewicz, Prather, & Bos, 2014) with the majority enrolling in developmental mathematics more than any other subject area (Bahr, 2011; Le, Rogers, & Santos, 2011). Bailey, Jeong, and Cho (2009) found that fewer than 50% of students who enroll in developmental coursework, regardless of discipline, actually complete the sequence and achieve college-level readiness.

Data obtained by the National Educational Longitudinal Study stated that about 68% of students passed their developmental writing courses, 71% passed their developmental reading courses, and only 30% passed their developmental mathematics courses (Attewell, Lavin, Domina, & Levey, 2006). As a result, several programs and pathways have been created to attempt to bridge the gap between math-skill deficiency and college-level proficiency. Accelerated programs, self-paced classes, and hybrid courses are just a few examples of learning environments intended to shorten the amount of time a student needs to reach college-level readiness (Le et al., 2011). Such course formats potentially allow a student to take more than one math course in a sequence

within a single semester. Despite various configurations of the course learning environment, students are still struggling to develop their math skills (Boatman, Long, & National Center for Postsecondary Research, 2011; Le et al., 2011). To determine the pedagogical practices effective in enhancing student success, it is important to learn more about the population of students in developmental mathematics courses.

Research shows that the average student in developmental courses is nontraditional (Bahr, 2011; Rendón, 1995; Scott-Clayton & Rodriguez, 2012). A nontraditional student is one for whom college is not a part of his or her upbringing (Rendón, 2002). Demographic descriptors of nontraditional students include the first-generation college student, and/or minority, low-income background, or adult student. Since the population of students in developmental courses tends to be nontraditional, Barnett (2011) emphasized the need to explore pedagogy related to enhancing success of the nontraditional student.

One concept proven to increase student success in developmental courses is the implementation of supportive factors by faculty members (Acevedo-Gil, Santos, Alonso, & Solorzano, 2015; Barnett, 2011; Rendón, 1994, 2002). Studies have shown that when faculty members make an effort to bridge and make a connection between students and the college experience, students tend to perform better and feel a greater sense of belonging (Rendón, 2002; Rendón, Nora, & Kanagala, 2014; Zientek, Schneider, & Onwuegbuzie, 2014). As such, faculty members become the first line of support in encouraging these students and promoting the idea that they are capable learners (Barnett, 2011; Lundberg, 2010). It has been shown that students in developmental courses experiencing academic and interpersonal validation by agents inside the classroom tend



to have a much smoother college transition, tend to have more positive outlooks on the college experience, and tend to persist longer than the average student in a non-supportive developmental classroom (Acevedo-Gil et al., 2015; Barnett, 2011; Colorado-Burt, 2015; Garcia, 2015). The term *agent* as it applies to the classroom refers to faculty members, teaching assistants, and peers. If students are offered support by such agents within the classroom, they may feel a sense of confidence and motivation that could translate into persistence and retention.

Beyond supporting students in the classroom, community colleges vie to reach diverse populations of students by offering a variety of certification and 2-year degree programs. The benefits of such programs are that they offer students the skills necessary for immediate employment upon graduation within a shorter time span than that offered by 4-year institutions. As reported by Kochan, Finegold, and Osterman (2012), students with certifications or degrees in the science, technology, engineering, and mathematics (STEM) related fields are in high demand. Not only could students be able to secure jobs in the middle-skill workforce upon graduation with a STEM-related degree, but they could be able to earn comparable salaries to those with bachelor's degrees (Holzer & Lerman, 2007). By encouraging students to enroll in and persist through STEM-related programs, community college faculty and staff are helping students to both graduate and become eligible to fill the middle-skill workforce. With STEM fields growing at a rate that is three times faster than non-STEM-related fields, it has become increasingly important for community college students to fill this high-need area (Peterson, Bornemann, Lydon, & West, 2015). Holzer and Lerman (2007) found that increasing employment in the middle-skill workforce positively impacts the ability for the United

States to compete in the global economy. With this in mind, community colleges are seen to be central to that endeavor.

To establish a foundation for this study, this chapter outlines the differences between the terms *remedial* and *developmental*, describes the financial aid concerns of students in community colleges who are attempting to develop their skill deficiencies, and demonstrates the lack of a middle-skill workforce created by students not earning credentials in STEM-related fields. This chapter also provides the theoretical rationale through which this study was explored, and it states the problem of interest, the purpose of the study, the research questions, and the significance of the study.

### **Background of the Study**

To understand the nature of developmental courses, it is important to note, first, the differences between *remediation* and *developmental* education. As well, financial aid availabilities and constraints must be understood to determine the impact that taking developmental coursework has on a student attempting to reach college-level readiness. A lack of a middle-skill workforce must also be considered, as the need for encouraging students to enter STEM-related fields continues to become increasingly important.

**Remedial vs. developmental education.** Remediation began as a means of remedying a problem, such as a deficiency in a skill area that required a prescriptive measure. “The focus of remedial education was primarily on cognitive deficits and not improvements in the affective domain” (Arendale, 2005, p. 69). The term remediation had negative connotations in its implications for needing to “fix” a student’s particular area of deficiency as opposed to what developmental education was designed to offer students (Boylan, 2001; Casazza, 1999). The focus of remediation was to examine

student skill deficiencies and then provide the necessary support to address the specific deficiency. Remediation implies that if a student has a deficiency, then there exists a remedy that could improve it. Boylan (2001) and Casazza (1999) argued that it is not enough to simply try to remedy the deficiency. They argued that the student may lack sufficient time-management skills, study and note-taking skills, motivation or emphasis on producing quality work, and support systems or proper guidance. Because of this, developmental education was created to ensure that students were being supported both academically and personally (Arendale, 2005; Boylan, 2001; Casazza, 1999).

Developmental education is a format in which students can address most school-related deficiencies in an effort to be successful.

To address school-related deficiencies, modern developmental education “involves a range of services designed to promote personal and academic development. . . including counseling; advising; tutoring; individualized instruction; and courses to enhance study skills and strategies, promote critical thinking, or introduce students to rewards and expectations of college” (Boylan, 2001, p. 2). By this definition, it appears that remediation refers to addressing a specific deficiency in a skill area and taking steps to ameliorate that problem, while developmental education refers to addressing many facets of the college experience for the student needing assistance with any skill deficiency (Boylan, Bonham, & White, 1999; Rubin, 1987). While there is value in remedying a skill deficiency, the reality is that most students lack skills in areas beyond just course subject matter, and developmental education helps to address such concerns.

This study focuses on the concept of developmental education rather than the narrower focus on remediation of skill deficiency. However, the choice of wording within

the literature examined in this study, remedial versus developmental, will be reported as described by the researchers themselves to ensure accuracy.

**Institutional barriers.** A student's path to academic completion is challenged by the various barriers set forth by institutional and federal policy. Concerns of many students begin with placement testing that determines if students must complete developmental course work prior to reaching college-level courses. If a student must complete developmental coursework, the availability of, and limitations on, financial aid becomes another concern and a potential barrier to completion. Given that most developmental courses are non-credit-bearing courses, funds that would normally be used to cover college-level courses are exhausted by the need to complete developmental courses.

The most common assessment and placement (A & P) testing instruments in community colleges across the United States are The College Board ACCUPLACER and the ACT COMPASS (Melguizo et al., 2014). Within A & P testing, more consistent scores better serve students. These scores measure college readiness, smooth transitions between 2- and 4-year institutions, measure the effectiveness of developmental education sequences, adequately prepare students for college-level work, and accurately place students in course levels (Melguizo et al., 2014). Proponents argue the consistent scores provided by A & P testing allow students and colleges to gain information and direction.

Opponents argue that having uniform A & P practices prevent institutions from individualizing strategies to help students reach college-level readiness, increase costs associated with assessment, and result in higher enrollment of nontraditional students in developmental education (Melguizo et al., 2014). Bettinger, Boatman, and Long (2014)

indicated that there is a disproportionate number of students being placed into remedial programs, which indicates a need for further investigation into A & P testing practices. When students are placed in developmental courses, it takes a longer period of time for them to progress through the sequence of courses needed to satisfy degree requirements. This issue becomes compounded if the student must take multiple courses in a single developmental sequence before reaching college-level course readiness.

Once community college students are placed in developmental courses, the availability of financial aid becomes a significant concern. Currently, using financial aid for developmental education is a controversial subject within community colleges across the nation. State and federal funding agencies spend upwards of \$2.3 billion on developmental education alone (Bautsch, 2013; Crisp & Delgado, 2014). As Bahr (2008) stated regarding the controversy behind developmental education:

On one hand, it fills an important niche in U.S. higher education by providing opportunities to rectify disparities generated in primary education and secondary schooling, to develop the minimum skills deemed necessary for functional participation in the economy and the democracy, and to acquire the prerequisite competencies that are crucial for negotiating college-level coursework. On the other hand, critics argue that taxpayers should not be required to pay twice for the same educational opportunities, that remediation diminishes academic standards and devalues post-secondary credentials, and that the large number of underprepared students entering colleges and universities demoralizes faculty.

(pp. 420-421)

Bahr (2008) argued that, because of the critiques, many institutions have questioned the effectiveness of remedial programs and have considered removing the requirement for remedial courses altogether.

Developmental education has become a means of addressing underprepared students. Therefore, states across the nation have been devising strategies to either eliminate the need for developmental coursework or to limit the time it takes for students to develop skills. In 2002, a study conducted by Jenkins and Boswell showed that of the 42 responding states, Alaska, Nebraska, Wyoming, and Wisconsin banned the use of financial aid to pay for developmental course work. The students were responsible for funding their own developmental education, thus closing the options for financial aid despite need. Additionally, 13 states placed a limit on financial aid after a specific number of attempts made to complete a single developmental course. If a student fails a course, financial aid may only cover a set number of attempts before the student is responsible for covering those course costs (Jenkins & Boswell, 2002).

In the United States, six states: Georgia, North Carolina, South Dakota, Tennessee, Texas, and Wyoming, all have state-mandated requirements for students to take a college placement exam. California, Maine, and South Carolina advise students to take developmental courses but do not enforce that decision. The desired goal behind enforcing these constraints is “to select those alternatives that are least costly for reaching a particular objective or that have the largest impact per unit of cost” (Pretlow & Wathington, 2012, p. 5). It is left to the discretion of the student if he or she wishes to enroll in any developmental courses, despite the acknowledgment of being deficient in any particular subject area.

Similarly, in Florida, the legislature passed Senate Bill 1720 (Florida Senate, 2013), which ensured that high school graduates and active-duty military were no longer required to take placement tests to determine college-level readiness. By holding a high school diploma, they would be exempt from having to take any testing to determine placement—even if advisors recommended developmental coursework (Fain, 2013). The goal of the bill was to cut budgetary costs by allowing students to bypass developmental course work. Yet, the gap between the educational skills the students had and the skills the students needed to have was not addressed. There are concerns that the effects of the legislation will only show a much higher dropout rate, indicating a shortage of prepared students (Roubides, 2015).

**Importance of middle-skill workforce.** The lack of a middle-skill workforce is another concern that lends importance to the number of graduates from community colleges in the United States (Holzer, 2012). Community colleges offer various STEM-related, 2-year certification and degree programs for students hoping to enter the middle-skill workforce. Middle-skill jobs are available to those with less than a bachelor's degree, and they require proficiency in math, science, or technology (Holzer & Lerman, 2007). Approximately 25 million middle-skill jobs are unfilled (Kochan et al., 2012). Low community college graduation rates impact a void that could be filled by nontraditional students. Holzer (2012) predicted that middle-skill employment opportunities would constitute approximately 47% of all new job openings in areas such as medical technicians, construction, manufacturing, as well as technicians in various STEM fields. With students being unable to complete their 2-year degrees and then apply for employment in these areas, companies are sending their operations to other countries

(Kochan et al., 2012). By increasing completion rates in developmental coursework for community college students and preparing them for employment in middle-skill jobs, colleges may simultaneously be helping the US to remain competitive and offer those students financial stability and career advancement (Holzer, 2012; Kochan et al., 2012).

Unfortunately, the idea of middle-skill employment is undervalued due to its misconception of producing low-wage jobs. Students are not being properly educated on the necessity for a trained workforce in these high-needs areas, and they are not seeing these preparation programs or degrees as valuable (Stone, Blackman, & Lewis, 2010). Stone et al. (2010) found that there is less importance placed on middle-skill occupations than on those high-skill occupations requiring 4-year degrees.

If community college faculty and staff were actively making students aware of the potential for financial stability and job security, enrollment in middle-skill certification and degree programs might increase (Peterson et al., 2015). At the same time, by improving success rates in developmental mathematics, greater numbers of students would be able to pursue and complete STEM-related programs (Peterson et al., 2015). It is reasonable to expect that if community colleges can graduate a greater number of students in STEM-related degree and certification programs, students may then gain employment in STEM-related fields and begin to decrease the middle-skill gap.

### **Statement of the Problem**

Understanding the factors that influence the success of community college students has been a priority since the end of the 20<sup>th</sup> century. Concerns surround the fact that more than 50% of community college students enroll in at least one developmental course (Bahr, 2011; Wolfle, 2012), and less than 46% of students who enroll in



developmental courses actually complete the sequence and reach college-level readiness (Bailey et al., 2010). Those enrolled in developmental courses were placed using assessment and placement instruments, which can sometimes indicate the need to complete multiple courses in a single sequence (Melguizo et al., 2014). Having to complete multiple courses prior to reaching college-level readiness can deplete the amount of financial aid funding available to students attempting to earn credentials (Bettinger et al., 2013; Melguizo et al., 2014). Therefore, enrollment in developmental sequences can become a financial detriment to students, and it may prevent them from having aid available when they reach college-level courses.

Placement tests and financial obstacles are challenges for community college students who require support in mathematics. However, until these challenges are addressed, nontraditional students who are currently enrolling in community colleges need nontraditional supports to move forward (Bailey et al., 2010; Lundberg, 2010). The prevalent theoretical models for curriculum and delivery are more applicable to traditional students. Studies have shown that institutions must improve how they support and retain the continuously growing nontraditional student population (Oseguera, Locks, & Vega, 2009). Barnett (2011) stated that the issue that needs much more research is the direct impact of faculty on student performance—precisely the effects of faculty support on diverse populations of students within community colleges. The population of students in developmental mathematics is an example of the type of diverse population to which Barnett was referring. Researchers have examined faculty characteristics relating to the success of students in developmental math (Hester, 2011), faculty perceptions and expectations for student success in developmental math (Ellerbe, 2015; Zientek et al.,

2014), as well as student perspectives on faculty validation in developmental English and math courses (Acevedo-Gil et al., 2015); but there is no research that directly compares math faculty and students in developmental math courses. Furthermore, studies have shown that there is a greater occurrence of non-supportive factors in developmental mathematics classrooms when compared with developmental reading or writing courses (Acevedo-Gil et al., 2015). The study conducted by Dudley, Liu, Hao, and Stallard (2015) compared engagement between faculty and students, but it did not address the supportive factors reported by each group. The current study aimed to address the current gap in the literature, that is, a comparison of faculty and student reports on the prevalence or existence of supportive factors inside and outside of developmental mathematics classrooms. The study examined supportive strategies that faculty identified as important for developmental mathematics instructors and compared these to the supportive faculty strategies identified by students.

### **Theoretical Rationale**

Rendón's (1994) theory of validation was employed and served as the lens for exploring the impact of the academic and interpersonal components of supportive measures. Rendón's theory is pertinent to this study because it supports the notion of faculty being the first line of opportunity for keeping students motivated and focused on reaching their educational goals. Validation theory allows for a greater understanding of how faculty can play a significant role in the development of students.

Research has been conducted on the effects of validation on nontraditional students in the developmental reading and writing arenas (Acevedo-Gil, et al., 2015; Barnett, 2011; Colorado-Burt, 2015; Garcia, 2015; Lundberg, 2010; Rendón, 2002), but

the research has yet to be conducted within the mathematics arena. When faculty members employ supportive strategies within their developmental reading and writing courses, students describe having a transformative experience (Jehangir, 2009). Students reported feeling a sense of belonging, as though there was someone who was genuinely invested in their well-being. This tends to translate into better performance in classes or, at the very least, having a positive and affirmative college experience (Jehangir, 2009; Rendón, 2002). Given that students perform so poorly in developmental mathematics classrooms, it seems reasonable to explore the impact of supportive faculty strategies to determine if there is a similar transformative experience felt by mathematics students. The transformative experience may result in improved overall performance.

In a study conducted by Acevedo-Gil et al. (2015), students were found to have had numerous invalidating experiences within mathematics classrooms. The researchers noted that there was a greater frequency in the occurrence of invalidating experiences within the developmental mathematics classroom, compared to the reading and writing classrooms. Because of such frequencies, the researchers believed it was important to identify supportive faculty strategies within mathematics classrooms. Besides the issue of lacking necessary supportive structures, Rendón (2002) explained that nontraditional students rarely see themselves reflected in the curriculum. They arrive at college with little to no guidance or understanding of the academic rigor that lies before them. Generally, they are the first in their families to attend college. Rendón noted that this foreign experience results in feelings of incompetency and a sense of misplacement. Moreover, nontraditional students are not inclined to seek out guidance and tend to struggle with adjusting to college life.

**Definition of validation theory.** Validation theory defines the role of inside and outside classroom agents and describes the potential impact such agents can have on nontraditional students and their college development (Linares & Muñoz, 2011; Rendón, 1994). According to Rendón (1994), validation theory has six essential elements:

1. *Taking initiative.* Institutional agents, such as faculty members, counselors, or advisors, must take the initiative in reaching out to students. Rendón explained that nontraditional students tend to be afraid of asking for guidance or input for fear of appearing lazy or incompetent. These students simply do not realize that they can ask for help and direction through the college process.
2. *Understanding that validation has been proven to increase a student's perception of self-worth and feelings of competency in a new college setting.* Rendón made the claim that when students are validated by inside and outside classroom agents, they feel better about themselves and realize they are worthy of obtaining an education.
3. *Regular validation of students leads to them to being more apt to become actively involved in the college community.* Rendón described the third element of validation as being a key link to improving student development. Supportive agents have an opportunity to ensure and encourage these nontraditional students to become more involved and take part in academic life, even if these students claim to not have the time needed to remain on campus after classes and become involved with non-academic college activities.

4. *Validation can happen both inside the classroom and outside the classroom.*

Validation occurs within the classroom by agents who include faculty, peers, or teaching assistants. Outside of the classroom validation occurs through agents who include family members, friends, relationship partners, school advisors or counselors, coaches, or tutors. Rendón explained that validation is not an isolated matter and allows for greater chances of reaching students and motivating them toward success.

5. *Validation must be present regularly throughout a student's college experience so that the student has a much richer academic experience.* It is not a one-time event; it is dynamic and ongoing so that it is truly effective.

6. *Validation must be implemented very early in a student's college experience, especially during the first 2 weeks of class and throughout the entire first year.* Considering that entering a new and foreign experience as a nontraditional college student can be frightening and intimidating, Rendón (1994) posited that it is important to have validating agents support the student along the way. This support can happen on two distinct levels of validation: academic validation and interpersonal validation (Linares & Muñoz, 2011). By employing both levels of validation, the chances at an affirming college experience become greater for nontraditional students.

According to Rendón (1994), academic validation occurs when agents inside and outside the classroom assist students in recognizing their full potential as well as their worthiness of being academic learners. Faculty members may create curricula designed to showcase the individual students, allowing them to share personal histories and feel like

an integral part of the learning process. Faculty members can create a community feel in the classroom environment thus permitting open and honest communication among peers. Interpersonal validation occurs when agents inside and outside classroom work with students to develop their personal and social adjustment to the college experience. In this way, faculty members can encourage students to form study groups and promote collaboration among peers allowing them opportunities to validate each other. Validation theory recognizes that not all students transition to college life equally, therefore validation is used to promote confidence and encourage success even in the most uncertain of students (Rendón, 2002). To create and sustain a supportive environment means allowing nontraditional students to feel like they belong to the college community and feel less inhibited in their participation.

**History of validation theory.** In the early 1990s, Rendón & Jalomo (1995) conducted a qualitative study focused on “assessing the influences of students’ out-of-class experiences on learning and retention” (Linares & Muñoz, 2011, p. 13). The researchers interviewed 132 first-year students from four different collegiate institutions. Questions included how the students chose their respective colleges, who impacted their transition to college life, what their expectation versus the reality of college rigor was like, and what were the general effects of their collegiate experience. Initially, the researchers were analyzing data using Astin’s (1984) theory of involvement as their theoretical lens, but they quickly realized that “there were stark differences in the way low-income and affluent, ‘traditional’ students experienced the transition to college” (Linares & Muñoz, 2011, p. 14). They also noted that “low-income students suddenly began to believe in themselves, not so much because of their college involvement, but

because some person(s), in- or outside-of-college took the initiative to reach out to them to affirm their innate capacity to learn” (Linares & Muñoz, 2011, p. 14). As the researchers continued to explore the student responses, they decided to apply the term *validation* to the feelings and experiences described by those students as they transitioned to college life. The transformative power of validation was just beginning to be explored.

In 1994, Rendón theorized the implications of validation for student development. She posited that “validation theory provides a framework that faculty and staff can employ to work with students in a way that gives them agency, affirmation, self-worth, and liberation from past invalidation” (Linares & Muñoz, 2011, p. 17). She argued that for nontraditional students, validation is needed to encourage them to recognize their own capabilities and transition from self-doubting students to confident, competent individuals on a journey to academic success.

Given that validation theory describes the power that a faculty member can have on nontraditional students, it is important to explore what the potential impact may be on the developmental mathematics student population. Validation theory is readily applicable to nontraditional student populations and addresses the transformative experiences students undergo with the appropriate in- and out-of-class support systems. Considering the current knowledge of applications of validation in- and outside of the classroom, it can be extended to untapped arenas where validation has yet to be applied: students in developmental mathematics courses.

### **Statement of Purpose**

The purpose of this study was to examine supportive strategies inside and outside of developmental mathematics classrooms in community colleges. Since less than half of

enrolled students currently complete developmental math courses, it was critical to research strategies that would lead to greater success. This study contributed to a greater understanding of what supportive strategies faculty members reported implementing inside and outside classrooms and whether the students reported experiencing those behaviors. A comparison of faculty and student reports allowed for determining the importance and impact of supportive faculty strategies on students enrolled in developmental mathematics courses.

### **Research Questions**

This study applied validation theory elements to obtain more information regarding the academic relationships between faculty members and students in developmental mathematics classrooms. The following questions guided the study:

- 1a. What supportive factors are incorporated in classrooms as reported by *students* in developmental mathematics classrooms?
- 1b. What supportive factors are incorporated in classrooms as reported by *faculty* who have taught developmental mathematics?
- 2a. What supportive factors are incorporated outside the classroom as reported by *students* in developmental mathematics classrooms?
- 2b. What supportive factors are incorporated outside the classroom as reported by *faculty* who have taught developmental mathematics?

### **Significance of the Study**

This study informs mathematics educators of supportive factors that are most effective in contributing to perceived successful classroom and college experiences. The study identified commonalities and differences between student reports of existing



supportive strategies and faculty identification of strategies valuable to the education process and to their role as instructors. The research serves to promote professional development aimed at increasing the practice of supportive strategies that can enhance the experience of students in developmental mathematics courses. With student experiences and faculty perceptions as the driving force behind this study, pedagogical practice may be informed by the results obtained. Community colleges can offer professional development based on the supportive strategies reported by students in developmental mathematics courses with the intention of bridging the connection between faculty members and their students.

This study also provided an opportunity for nontraditional students to identify which supportive strategies were being practiced inside and outside of the developmental mathematics classroom. By educating faculty and staff in an effort to address any reported gaps, there may be a greater effort to increase the frequency of supportive factors. A more consistent, supportive environment may encourage students to complete their developmental mathematics sequences and enroll in college-level math.

### **Definitions of Terms**

*Agents* – used to describe the individuals who provide academic and interpersonal support to students inside the classroom, such as faculty, teaching assistants, and peers, as well as outside of the classroom, such as family members, friends, relationship partners, school advisors or counselors, coaches, or tutors (Rendón, 1994).

*Developmental Education* – “is a field of practice and research within higher education with a theoretical foundation in developmental psychology and learning theory. Developmental education promotes the cognitive and affective growth of all

postsecondary learners, at all levels of the learning continuum” (National Association of Developmental Educators, 1995, para. 3).

*Middle-skill*– adjective used to describe occupational skills that “generally require some significant education and training beyond high school but less than a bachelor’s degree. . . can include associate’s degrees, vocational certificates, significant on-the-job training, previous work experience, or generally some college less than a bachelor’s degree” (Holzer & Lerman, 2007, p. 8). Middle-skill jobs, workers, occupations, employment are all represented in the literature.

*Nontraditional Students* – students who “come from low-income, working-class backgrounds and are often the first in their family to attend college. Many are students of color, and a high number of white students can be considered nontraditional” (Rendón, 2002, p. 646).

*Remedial Instruction* – “Instruction (during the progress of a course or study of a body of material) in acquisition of basic pre-requisite skills which are essential for eventual success in a course” (Ross, 1970, p. 30).

*Traditional Students* – learners who come from middle- or upper-class backgrounds, come from families where the expectation of attending college is a normal part of family tradition, and where one or more family members attended college (Rendón, 2002).

## **Chapter Summary**

Chapter 1 provided a review of the background of developmental education in community colleges and outlined the differences between *remedial* education and *developmental* education. Institutional barriers, such as financial aid and placement

testing, continue to hinder students on their paths to successful completion of developmental coursework. Because of the continued drop in community college student success rates, middle-skill jobs remain unfilled, and the economy remains impacted. To address these concerns, it is important to find ways of increasing math proficiency so that students can graduate from STEM-related programs and be eligible to enter the middle-skill workforce. Students entering developmental coursework tend to be nontraditional; so, nontraditional supports must be explored to increase success rates. Rendón (1994) described validation theory as a type of nontraditional support. This theory indicates that academic and interpersonal validation provided by supportive agents, inside and outside of the classroom, empowers nontraditional students to be successful. The purpose of this study was to determine what supportive strategies, important to community college mathematics faculty, were also reported as important to students in developmental mathematics classrooms. Increased information comparing the two groups provided a foundation for professional development aimed at reaching nontraditional students in community colleges. In Chapter 2, a comprehensive literature review is detailed; Chapter 3 provides the research methods for the study, Chapter 4 presents a detailed analysis of the results and findings, and Chapter 5 discusses the findings, implications, and recommendations for future research and practice.

## Chapter 2: Review of the Literature

### Introduction and Purpose

The purpose of this study was to examine supportive strategies in developmental mathematics classes in community colleges. The study determined the alignment between students' need for, and faculty employment of, supportive strategies within the classroom. This study sought answers to the following research questions:

- 1a. What supportive factors are incorporated in classrooms as reported by *students* in developmental mathematics classrooms?
- 1b. What supportive factors are incorporated in classrooms as reported by *faculty* who have taught developmental mathematics?
- 2a. What supportive factors are incorporated outside the classroom as reported by *students* in developmental mathematics classrooms?
- 2b. What supportive factors are incorporated outside the classroom as reported by *faculty* who have taught developmental mathematics?

To understand the motivation behind this study, it was important to explore the research that has been conducted so far. First, this chapter includes a section on faculty validation. The chapter outlines the impacts of, and supportive strategies from, institutional agents, as well as providing what validation looks like in the developmental classroom. Next, learning communities, as supportive pedagogy and research on implementing learning communities, including how faculty played a role in supporting the students enrolled, are examined. Finally, the chapter concludes with a section on

understanding student learning barriers and success through an examination of a collection of studies aimed at understanding success from the student and faculty perspectives.

### **Faculty Validation**

Terenzini et al. (1994) conducted a study that set the foundation and uncovered the concept of faculty validation of students. This qualitative study examined the transition to college as perceived by both traditional and nontraditional students at four different institutions. Traditional students were defined by the researchers as those students who viewed college as a normal part of life with many examples of college graduates among family members and friends. Nontraditional students did not have that college exposure and were most likely juggling families, jobs, and college classes. The research conducted by Terenzini et al. (1994) showed glaring differences between traditional and nontraditional students in their perceptions of a successful college transition, in the way family and friends contributed to each group's college experience, and in the value placed by each group on academic and interpersonal validation.

For traditional students, college was simply a natural continuation of learning (Terenzini et al., 1994). Throughout their upbringing, these students were accustomed to the idea that college was a required part of being a successful adult. It followed that when these students transitioned to college life, family and friends were generally assets in helping to smooth out the experience by offering financial and emotional assistance (Terenzini et al., 1994). Traditional students tended to worry more about making friends and fitting in and less about the academic side of college life. They tended to have few reservations about reaching out to college staff and support members when needed, and

they saw merit in belonging to various non-academic activities (Terenzini et al., 1994; Rendón, 2002).

Nontraditional students had a more challenging time transitioning to college. Their experience was that college was a disjunctive process for them. Terenzini et al. (1994) found that nontraditional students tended to use college as a means to escape their current life situations, or as a means to find a better way of life than was projected for them. One of the students interviewed described going back to school as an escape from the violence in his own community. He decided that to make a difference, he needed to become educated and find a way out of his circumstances. Having been brought up surrounded by homicide, he realized that he needed to find distance and make a life for himself through legitimate means.

Nontraditional students in the Terenzini et al. (1994) study also had another barrier to being successful in college life: family and friends who did not buy in to the positive impact and growth potential that can be achieved by attaining a college degree. Terenzini et al. (1994) noted that these students cited their friends as “interpersonal anchors.” This meant that their friends had a difficult time accepting the life changes being made by the nontraditional student and would then pose as negative influences, attempting to tempt the nontraditional students to maintain old habits (Terenzini et al., 1994). These friends did not believe in the possibility of an improvement in social status through the means of education.

Nontraditional students tended to struggle with pressures placed on them from family and friends who criticized their decisions to attend college; therefore, these students needed to find their sense of belonging within the classroom and on the college

campus. Terenzini et al. (1994) showed that nontraditional students often cited validation from a faculty member or support staff at the college as being a critical component of their decision to persist. These students talked about invalidating experiences that exasperated their struggles, while others described their validating experiences where faculty found ways to encourage them to work diligently and structured the classes so that the students could see themselves as capable learners. For traditional students, validation was experienced by simply being accepted into the college of their choice. The interview findings of the Rendón and Jalomo (1995) and Terenzini et al. (1994) studies established academic and interpersonal validation models, indicating key components that contribute to a successfully validating classroom and a validating learning community setting as the foundation for validation theory.

In 2002, Rendón went on to study the Puente Project, “a nationally award-winning program that emphasizes the cultural attributes of Latino students and socializes them to college through a multidimensional, integrative approach combining curriculum, counseling, and mentoring” (Laden, 1999, p. 56). The Puente Project was initiated to increase the number of Latinos in higher education through supportive faculty and administrative strategies, in addition to a student-centered curriculum with a heavy focus on increasing writing abilities. Rendón conducted her qualitative research by interviewing staff and counselors, who were participating and observing a Puente Project English classroom, and by analyzing student narratives on what the Puente Project meant to them. Her research questions addressed the desire to understand the components and impact of validation on the students from the faculty and staff at the college. From an analysis of the data she collected, she found that the students in the project felt a

transformative effect from the validating experiences provided by faculty and staff at the community college. Rendón (2002) noted that it was very important for faculty members to take initiative and make an impact on the students' lives. Through these faculty members' supportive strategies, academic validation existed. Traditional and nontraditional students did not exhibit similar ways of becoming engaged, and they did not take advantage of college activities just because they were being promoted by the college. This study showed that the students benefited from direct and genuinely supportive validation, and the staff recognized the importance of reaching out to students and showing them they were valuable learners. To sum, she found that the members of the Puente community went beyond expectations by providing social, emotional, and personal life skills through means of attention to students' personal development (Rendón, 2002).

Validation of students remains a current topic of interest and it has been explored in various studies to determine the impact on different populations of students. One such study was conducted by Hurtado, Cuellar, and Guillermo-Wann (2011) in which they explored the differences in perceptions of academic and interpersonal validation between White students and students of color. Using the Diverse Learning Environment Survey, the researchers collected data from 4,472 students from three community colleges, six public 4-year institutions, and five private 4-year institutions. The data, showed that 57.6% of the population surveyed were students of color with two-thirds being first-generation college students. Using the 12-item questionnaire, it was found that the mean scores for both in-class academic validation and general interpersonal validation were significantly higher for White students than for students of color. In-class academic



validation was reported at much lower levels by students of color than was the general interpersonal validation. The researchers also found that students' sense of validation depended on their interaction and experience with faculty and staff. As reported levels of in-class academic validation increased, so did the reported levels of general interpersonal validation (Hurtado et al., 2011). Students wanted not only to be supported in the classroom, but they also wanted to be supported outside of the classroom.

The impact of faculty validation was further explored in the context of community college STEM students' persistence and success (Hester, 2011). The quantitative study was conducted to determine the relationship between demographic variables, such as gender and race/ethnicity of faculty and students, and validation scores for STEM students in community college; demographic variables and academic success and persistence for STEM students in community college; and the influence of validation scores on academic success and persistence for STEM students in community college.

Hester (2011) found that students reported higher levels of validation when they were enrolled in female-taught courses. Gender was the only variable that showed any significance in the relationship between demographic variables and validation scores. Considering the student population comprised a vast majority of females, it is possible that same-gender role-model effect influenced student perceptions of faculty validation or behaviors of female faculty. Specifically, female students reported feeling validated by their female instructors who recognized their hard work, gave positive and constructive criticism, and consistently created a sense of community. Both male and female students reported instances of invalidating experiences with male faculty in the community college. This could have been due to the reported sense of nurturing and sensitivity that

female faculty provided whereas the male faculty were reported to be harsh and emotionally distant (Hester, 2011). Students enrolled in classes taught by male faculty may have been exposed to a more rigid environment than those classes taught by female faculty.

Considering the relationship between demographic variables and academic success and persistence, Hester (2011) found two statistically significant relationships that were contrary to previous findings. Based on the data she collected, she found that students of color tended to earn higher grades than White students. Hester (2011) made note that the college had been awarded a multi-million-dollar STEM grant to provide support services for underrepresented students and commented that students of color did cite support services as central to their academic success. Her second significant relationship was that students performed better in classes taught by White faculty members. She commented on having no reason to believe that White faculty ballooned grades but did comment that this relationship showed a small-to-medium effect size.

The analysis of the data related to exploring the influence of validation scores on academic success and persistence showed that students who reported higher perceptions of faculty validation also tended to earn higher grades. If students felt they belonged to the community of learners and were supported by faculty, they were motivated to work hard and deliver academically. Hester (2011) noted that student perception of validation by faculty was a strong predictor of academic success and represented a large effect size. Lastly, Hester (2011) found that gender was a good predictor of success if students perceived faculty members to be validating agents.

Faculty validation and student intent to persist is another relationship of interest. Rendón (2002) argued that validation might be important to the success and persistence of nontraditional and underserved students in community colleges. With that in mind, Barnett (2011) conducted a quantitative study using correlational methods in which she developed an instrument to effectively measure faculty validation. She surveyed 333 degree-seeking students at a Midwest college who attended credit-bearing classes with the goal of understanding the meaning of validation for these students. She used the survey to explore whether faculty validation contributed to a student's sense of academic integration and if those experiences contributed to the student's intent to persist. The data analyzed and recorded indicated there was a strong positive correlation showing an  $R^2$  of .559 ( $p < .01$ ) between faculty validation and sense of academic integration. Within this context, she found that nontraditional students reported significantly higher levels of academic integration than did traditional students. The strongest predictors of sense of academic integration, in order from strongest to weakest, were "caring instruction, mentoring, students being known and valued, and appreciation for diversity" (p. 205). Barnett (2011) also found, with moderately high significance, higher levels of faculty validation predicted stronger student intent to persist. Hispanic and Black students showed significantly higher levels of intent to persist than White students. In terms of persistence, faculty validation and academic integration each were strong predictors. However, when faculty validation and academic integration were treated as independent variables and each applied to intent to persist, only academic integration had any significant relationship with persistence. Validation did not directly contribute to the level of intent to persist. It appeared there was a direct effect of academic integration on

persistence, and validation had an indirect effect mediated by a student's sense of academic integration.

Investigating the effects of specific nontraditional group subsets was the focus of researchers Acevedo-Gil et al. (2015). Specifically, the researchers conducted a qualitative study to explore the impact of academic and interpersonal validation on Latinos/Latinas in community college developmental English and math courses. Acevedo-Gil et al. (2015) were interested in collecting data to identify what pedagogical and curricular experiences Latinas/Latinos, who were placed in developmental education courses, encountered inside and outside of class. They were also interested in understanding how the pedagogical and curricular experiences informed the academic self-perceptions and outcomes of Latinas/Latinos. Acevedo-Gil et al. (2015) used critical race theory and validation theory as their lens for investigating the impact of validation on Latinos/Latinas.

Acevedo-Gil et al. (2015) analyzed data from interviews conducted between December 2010 and September 2012 through the Pathways to Postsecondary Success Project, funded by the Bill & Melinda Gates Foundation. Within this time period, the 110 students interviewed from three different Los Angeles community colleges comprised 87% traditionally aged students, 87% low-income status, 56% female, 66% Latino, and 60% second-generation Americans. Approximately 92% of the students were placed in at least one developmental skills class, and 77% were placed in both developmental English and math courses. The Latino student data were used for the research in this study.

The researchers found occurrences of invalidation and validation in the reported college experiences of the Latino students in their community colleges. The data were

saturated with reports of feeling academically invalidated through the lack of institutional support provided to them as developmental students, in addition to poor pedagogical practices within the classroom setting. This academic invalidation negatively affected the students' experiences in other classes by creating a sense of inadequacy. An example of this was when a student reported an experience in her developmental mathematics class. She asked a question pertaining to the functions of a calculator and the instructor, in front of the rest of the students, degraded her by inferring that her problem was that she could not "see" the function key (Acevedo-Gil et al., 2015, p. 110). The faculty member was more focused on placing blame on the student than providing a supportive learning environment.

On the opposite end of the spectrum, students reported academic validating moments via pedagogical practices. One student commented on how an instructor had taken the time to relate to the students, show genuine care and concern, while simultaneously maintaining a serious attitude regarding curriculum importance. The instructor taught the students in the English developmental course at what was perceived to be at a higher level than what was expected. The students appreciated that the instructor took the time to teach them more than just the basics. The instructor had invested time and energy to meet the needs of his students beyond what was outlined for the developmental course objectives. Acevedo-Gil et al. (2015) also found that students felt higher perceived levels of academic and personal validation when their identities were recognized by various institutional agents such as faculty, counselors, and coaches.

Finally, Acevedo-Gil et al. (2015) found that students' peers were a central source of academic and personal validation—especially in the cases where the students were

faced with poor pedagogical practices or invalidating moments. The students looked at their fellow peers as members of the same community enduring the same hardships. On many levels, they could relate to one another and create a support system intended to help each other persist through any struggles they encountered. Having that community of learners with similar identities, similar interests, and similar aspirations helped students to persevere despite the countless invalidating moments they encountered with faculty members throughout their college experience.

From their findings, Acevedo-Gil et al. (2015) proposed that a “critical race validating pedagogy” should be implemented in developmental education classrooms. The researchers merged critical race theory (CRT) and validation theory to effectively describe the experiences of minorities in developmental education courses. CRT allows for the investigation of racism and oppression on the experiences of minorities, while validation theory explores the impact of supportive strategies from institutional agents on minorities. Critical race validating pedagogy supports a platform where students can engage in dialogue, focusing on their resiliency and perseverance as low-income, undocumented or documented, first-generation students. They could reflect on their experiences in poorly resourced K-12 school systems and find ways to move forward as a community seeking to improve academic deficiencies. Developmental education instructors practicing critical race validating pedagogy not only develop curriculum that includes culturally relevant examples to validate the history and background of their diverse students, but provide consistent and caring feedback (Acevedo-Gil et al., 2015). The incorporation of learning communities is an example of a learning format designed

to help students acquire the knowledge base needed to be successful in college studies across disciplines while providing opportunities for faculty validation.

### **Learning Communities as Supportive Pedagogy**

Faculty members as validating agents goes beyond just offering in-class academic and interpersonal validation. Faculty members also strategize to enhance classroom learning formats to boost student learning. One such example is found in the intentional treatment of learning communities. Faculty members play a key role in successfully implementing learning communities where classes from multiple disciplines are blended to provide students a richer and greater educational experience. Engstrom (2008), Jehangir (2008), and Wilmer (2009) each explored the impact of establishing learning communities and the effect that the faculty had on their respective student populations.

Engstrom (2008) conducted a qualitative study by interviewing 182 students from three community colleges and one 4-year public institution. She was interested in understanding, through students' perspectives, what strategies faculty members employed to promote success. The students surveyed were enrolled in a curricular learning community course where at least one non-credit basic-skills course was interconnected with another basic-skills or general-education course. Nontraditional students were well represented in these courses where many were first-generation, working-class students, with a majority being immigrants from Eastern Europe, Central America, Asia, and Africa. Engstrom (2008) found that faculty played an important role in creating a safe and positive learning environment for the students. She noted that, for native English speakers, prior high school experiences left them feeling disconnected and invalidated. They learned very little from the lecture format prevalent at their schools, spent few

hours studying, if at all, and lacked the motivation to learn. For non-native English speakers, “their lack of confidence in their academic abilities, self-esteem, and identity as college students was directly tied to their ability to speak, read, and write English” (p. 9). Faculty members alleviated some of these concerns through (a) use of active learning pedagogies; (b) collaboration with colleagues creating an integrative curriculum; (c) structuring opportunities for students to develop the skills to navigate successfully through college; (d) validating their students by placing high, yet attainable, expectations, recognizing their students’ talents and knowledge; and (e) by continuously assuring students of their ability to be college learners (Engstrom, 2008). The faculty focused their efforts on ensuring that the students felt more comfortable and supported within the classroom despite any language barriers.

Through the analysis of the interviews conducted at the colleges, Engstrom (2008) noted the impact that the faculty had on student success was a positive one as students reported experiencing a transformation of behaviors and attitudes. The students went from being inactive and disinterested to engaged and excited about their learning. They perceived their confidence levels to increase immensely and even noted that they felt a sense of belonging to the community of learners. Engstrom (2008) concluded that if institutions were serious about increasing the success and persistence of nontraditional students, then they must begin by preparing the faculty with an understanding of the myriad needs of diverse students. Engstrom noted that faculty members must emphasize the importance of extending their learning with peers and taking advantage of campus supports as part of the course experience. She stated that faculty must also demonstrate a genuine care for their students and their students’ academic success. She finalized her



conclusions by stating the importance of incorporating effective dimensions of student learning and progress within pedagogy. This practice would aid in the success of first-year students because these students tended to need motivation to persist and needed assistance with their learning (Engstrom, 2008).

Establishing learning communities designed with multicultural curricula is a means to reach marginalized and isolated first-year, first-generation, low-income students (Jehangir, 2008). In a qualitative multiple-case study of seven cohorts at a public Midwestern research university, Jehangir (2008) explored the perceptions of students' experiences in a multicultural learning voices community (MLVC). The study captured their learning experiences as they responded to weekly reflective writing tasks. Analysis of the weekly prompts identified five themes among the students: (a) finding a place, (b) finding a voice, finding self, (c) conflict as a catalyst, (d) bridge-building, and (e) transformational learning.

The students found a place by discovering a sense of belonging or a sense of family within their community of peers. They shared stories and experiences, finding that many struggles encountered by fellow classmates mirrored their own experiences. Many of the students felt the college transition was lonely as they lacked exposure from close friends or relatives going to college, so being surrounded by students who had similar backgrounds helped to increase their drive and persistence. Additionally, being validated through recognition by faculty members and peers allowed these students to feel like they were exactly where they needed to be (Jehangir, 2008).

Jehangir (2008) discovered that a student's voice was directly tied to a reflection of self in the expression of why the student wanted to attend college and what aspirations

the student had for pursuing his or her goals. Her research showed that many nontraditional students found difficulty expressing themselves, so being prompted by classroom activities to divulge information allowed those students to find their voices and themselves (Jhangir, 2008). Engaging in discourse with fellow classmates also elicited a sense of voice by bringing past experiences to light and allowing for an understanding of such topics as the complexity of race relations. Jhangir (2008) pointed out that finding one's voice is risky for many nontraditional students. Finding their voice refers to their willingness to explore and share their world from a new, educated perspective with friends and families. The sharing of these academic experiences can be interpreted as threatening for those who come from the same background and are comfortable with their circumstances (Jhangir, 2008). Friends and family members may develop feelings of inadequacy and behave negatively toward the students.

The students described conflict as a necessary part of growth in their academic and interpersonal encounters (Jhangir, 2008). Faculty managed, facilitated, and modeled constructive conflict so that the students could be effective in their discourse and could maintain respect throughout disagreements. Students commented on having greater success when accepting that not everything will go smoothly and not everyone will agree all the time. A level of maturity was reached by the students being able to explore conflict in a peaceful way.

Jhangir (2008) stated that the students participated in the act of bridge-building by creating connections between lived experiences and school, by creating cognitive bridges, and by creating bridges amongst peers and faculty members. Faculty devised pedagogy so that the students would see themselves in the curriculum and would be able

to relate it to the real-world around them. Because the students were a part of such a diverse cohort, they learned to increase their cultural intelligence by dialoguing with one another.

Finally, the students described feeling a transformative experience through their participation in the learning community. Jehangir (2008) noted that while students showed a deeper awareness of social issues, it was uncertain whether the transformation would continue past completion of the program. Furthermore, it was unclear if the empowerment of the students impacted their persistence in college.

Wilmer (2009) conducted a quantitative non-experimental correlational design study with 120 students to determine the influence of learning communities on the interaction levels of developmental English students. She obtained self-reported data through a questionnaire and used it to explore how demographics and course format influenced the levels of student interaction at a West Virginia community college. Of the 120 students surveyed, 50 were enrolled in the learning community course, and 70 students were enrolled in a non-learning community course. The students in the learning community class were younger, more likely to be enrolled full-time, less likely to be first-generation, and had lower reading and writing scores than their counterparts. In examining the data, it was found that interaction levels of student-to-student, student-to-faculty, and faculty-to-faculty increased in all aspects when the learning community format was applied. Conducting independent sample *t*-tests showed statistically significant differences with  $p < .05$  between both groups, learning community versus non-learning community, in the level of peer interaction and the level of faculty interaction. This was not the case with the perceived level of faculty concern, level of

academic and intellectual development, or level of institutional and goal commitment.

Wilmer (2009) also obtained faculty testimonials that contributed to the verification that learning communities do increase student involvement. Specifically, faculty members made note of the benefit of requiring students to form study groups and create support systems, which were especially important to the developmental students. Intrusive advising is another component of the learning community in which faculty consistently communicated with students to gain insight into any issues that needed to be addressed. Wilmer (2009) noted the utility of learning communities by describing how faculty members could allocate campus resources for the purchase of glasses and hearing aids and providing them to students who needed them but could not afford them.

### **Understanding Student Learning Barriers and Success**

There are several studies (Brinthaupt & Eady, 2014; Capt & Oliver, 2012; Dudley et al., 2015; Ellerbe, 2015; Lundberg, 2010; Zientek et al., 2014) that examined faculty perceptions regarding the root causes for students' unsuccessful course or degree completion. The researchers also explored the perceptions of students regarding what faculty could do to help the students reach their academic goals. The studies looked at factors that contribute to or hinder the success of students of color, faculty's perceptions for students in developmental math courses, strategies that faculty reported employing when teaching adult learners, and differences in faculty and student perspectives on engagement and feedback.

Lundberg (2010) analyzed data collected from 2,659 students of color from the College Student Experiences Questionnaire (CSEQ) database housed at Indiana University's Center for Postsecondary Research. The 166-item questionnaire,

administered to the student from 1999-2001, assessed student involvement in college activities; the quality of relationships established with faculty and administration; as well as estimated gains of learning with a focus in areas of general education, intellectual skills, and science and technology. Lundberg (2010) found that if an institution demonstrated an authentic value for diversity, that component was found to be the strongest predictor for general-education learning, but it was the third strongest predictor when it came to gains in intellectual skills and science and technology skills. Lundberg (2010) argued that Rendón's (1994) claim that minority students value institutions that embrace diversity was supported by the results of the Lundberg study.

Lundberg's (2010) findings suggest that institutional value and emphasis on diversity, as well as students being involved in the college experience, greatly benefited students of color. Lundberg also stated that it is equally important to note that positive, quality faculty-student interactions were key in promoting the success of students of color. If faculty members were perceived by students to be supportive and helpful, gains were made in general education learning as well as intellectual skill development. It was also noted that frequency of interaction with faculty members was not predictive of gains in learning, but that quality of faculty-student interaction was predictive of gains.

Lundberg (2010) made the claim that when faculty incorporated library use and computers in the curriculum, students of color made gains in general education, science and technology, and in intellectual skills. However, course structures involving science or quantitative experiences had mixed effects on students. The course structure had positive effects on their science and intellectual skills, but it had a negative effect on general-

education skills (Lundberg, 2010). More information on determining the reasons behind the negative effects was recommended for future research.

Ellerbe (2015) and Zientek et al. (2014) conducted qualitative studies to explore faculty perceptions and expectations for student success in community college developmental math courses. Zientek et al. (2014) were interested in understanding why students were placed in developmental mathematics courses and what factors hindered their success. The purpose of the study conducted by Ellerbe (2015) was to develop a theory relating faculty expectations for the successful outcome of students participating in a redesigned developmental math course.

The study conducted by Zientek et al. (2014) consisted of using a two-question survey that asked 79 community college and 10 state college faculty members to describe factors they felt contributed to students' need to be placed in developmental courses, and for the faculty to describe factors they felt hindered student success in developmental mathematics courses. The researchers took the open-ended responses and categorized them by themes of academic and personal factors. The top three reasons, along with their percentages for students being placed in developmental math courses were: (a) time delay from previous mathematics course (50.56%), (b) lack of basic math skills (43.82%), and (c) mathematics course completion in high school (13.48%). The bottom three reasons were: (a) motivation (3.40%), (b) value of mathematics (4.50%), and (c) lack of effort (4.50%). With respect to a time delay from a previous math course, one faculty member commented that students entering college right after high school may not have taken a math class their senior year. This gap would essentially contribute to a loss of

mathematical skills, which could potentially cause the student to place in a developmental math courses.

With respect to the lack of mathematics skills, faculty members shared the opinion that students had been previously *spoon-fed* answers, so they were unable to think critically (Zientek et al., 2014). The faculty members believed the students lacked a solid foundation in elementary, middle, or high school math, and their teachers were expected to pass them regardless of proficiency and understanding. When math concepts became challenging, they felt that students ceased to put forth effort. The faculty commented on the notion that if a student is passed along, regardless of mathematics proficiency, then it must indicate to the student the lack of importance for understanding the concepts, which may then translate to very little value placed on gaining mathematical knowledge. As for mathematics course completion in high school, the faculty members believed that the students may have been passed along without actual attainment of mathematical knowledge. The reasons for this were believed to be sports related as students would be given passing grades to continue participating in their respective sports.

The results of the study conducted by Zientek et al. (2014) showed that the top three factors faculty members believed stifled student success were attributed to: (a) situational factors, like family or work responsibilities (41.57%), (b) attendance (29.21%), and (c) study skills (20.22%). The bottom three factors were attributed to: (a) a college instructor (2.20%), (b) a desire to persist (3.40%), and (c) a lack of interest (4.49%). The faculty members believed that besides academic behaviors that were not conducive to successful outcomes, such as poor study skills, lack of effort, or immaturity,

dispositional factors were a large hindrance to student performance. Some members felt that students might have been unhappy about being in a developmental course, or that they felt it was some form of punishment. The consensus was that students would be less likely to succeed due to a lack of value of the course itself and a lack of commitment. Finally, the faculty members felt that, since the students in developmental courses tended to be nontraditional, situational factors had a large impact on preventing successful outcomes. These students reported having to juggle work life and family life on top of attending classes. This constant balancing act was cited to be a significant barrier to students' successful outcomes by preventing them from being able to focus their energies on going to college (Zientek et al., 2014).

The study conducted by Ellerbe (2015) showed a very different perspective of faculty members teaching developmental mathematics courses. After interviewing five community college faculty members who solely taught developmental math (two were full-time, three were adjuncts, and all had over 10 years of teaching experience), Ellerbe (2015) noticed a great deal of pride and interest in students' success. The faculty members did not consider teaching developmental courses to be a burden and, instead, saw the experience as a challenge, as an opportunity to prove to students that, through their instruction, they could become proficient in math. One faculty member stated that "you can take students who have never had success in math before and actually help them become engineers" (p. 394). Another member spoke metaphorically about the developmental math student as being a boulder chiseled away to produce a diamond. The notion of transformation was evident in the faculty member's metaphor. In the establishment of a redesigned developmental mathematics curriculum, faculty members



felt that institutional expectations for success caused standards to be lowered and that professional development was not provided for the instructors of the course redesign. Since the bar had been lowered, faculty members felt they had to follow suit by lowering their expectations for student success. Ellerbe (2015) argued that “the implementation of academic policy in the developmental math classroom shaped faculty expectations for student success by influencing the cadence of academic press” (p. 395).

Capt and Oliver (2012), along with Brinthaupt and Eady (2014), analyzed faculty perceptions of successful outcomes and potential barriers for nontraditional students. Capt and Oliver (2012) focused on understanding the challenges that come with teaching underprepared students in developmental educational courses. Brinthaupt and Eady (2014) studied faculty members’ perceptions of teaching a specific subset of nontraditional students, namely, adult students.

In order to understand what faculty members perceive as challenges to developing and meeting the needs of academically underprepared students, as well as faculty perceptions of what are and are not effective pedagogical practices, Capt and Oliver (2012) conducted a qualitative case study at a Texas community college. Seven faculty members and eight administrators were interviewed, face-to-face, and three classroom observations were held. Additionally, the Learning and Study Strategies Inventory (LASSI) was administered to 77 students of the community college. The LASSI examined the students’ skill components (such as test strategies and information processing), will components (such as desire and attitude toward learning), and self-regulation components (such as managing time and study skills). The researchers

triangulated the data by comparing faculty perceptions with student reports of each group of components.

Capt and Oliver (2012) developed a taxonomy based on faculty perceptions of the different challenges associated with the type of student in developmental courses: general, traditional, nontraditional (25 years of age or older), first-generation, and English as a second language (ESL) international. To provide some examples, faculty members reported nontraditional students as having more obligations and experiencing greater academic anxiety than the other groups of students. They were described as low in confidence and showed greater lack of familiarity with technology. The faculty described the traditional students as lacking maturity and responsibility as well as being prone to academic dishonesty. After analyzing student data collected from the LASSI, the researchers found that faculty perceptions did align with student responses. Both faculty and students were consistent in their understanding of the challenges that each group of students faced.

The faculty members practiced pedagogy that they felt contributed to successful outcomes for the students. Faculty members reported incorporating college skills into syllabi and lectures, creating a safe and comfortable classroom environment, modeling proper studying techniques and offering guided notes, tutoring students individually, and employing active and collaborative learning techniques (Capt & Oliver, 2012). To meet the needs of the students, faculty members reported checking for accuracy of placement into the developmental course, requiring a lab component to give students more hands-on learning, and incorporating different learning formats, such as adult development ESL, hybrid, and flex-pace classes. Capt and Oliver (2012) tabulated faculty members'

response strategies to the student's challenges in areas of pedagogical practices, curriculum design, character of the instructors, and responsibilities for preparing new instructors.

Brinthaupt and Eady (2014) conducted a quantitative study with 171 faculty members on their perceptions of nontraditional learners, specifically those 25 years of age or older. Surveys were administered to 98 faculty members from a public university and 73 faculty members from a state community college. The researchers were interested to determine if the faculty members from either type of institution had varied attitudes toward adult learners in their classrooms and if the very presence of adult learners influenced faculty members to adjust their pedagogical practices. They were also interested in determining if there was greater importance held in one institution versus the other regarding the need for attending professional development workshops or conferences aimed at improving teaching strategies for adult learners.

Using one-sample *t*-tests, findings showed that the faculty generally enjoyed having adult learners in their classrooms. Brinthaupt and Eady (2014) reported that these nontraditional learners were more dedicated to producing quality work, cared more about their course grade, and were better at time management than traditional learners—in addition to being more apt to apply their gained knowledge to real-world applications. Faculty members also reported that having adult learners in their classrooms did not make teaching more challenging, and they did not believe that adult learners had weak critical thinking and study skills.

In terms of behavior, faculty reported treating their nontraditional and traditional students the same way. Brinthaupt and Eady (2014) posited that the faculty members

choose to treat every student the same to avoid demonstrating preferential treatment. Despite this finding, faculty did make attempts to encourage their adult students to participate in classroom activities and discussions at a higher frequency than traditional students.

Lastly, Brinthaupt and Eady (2014) found that community college instructors tended to have a greater interest in professional development aimed at improving pedagogical practices for adult learners. Though these community college instructors showed an interest in learning more about teaching adult learners, the university instructors reported attending more professional development activities or reading more articles and papers related to adult learners. Despite faculty members expressing an interest in developing curriculum aimed at enhancing adult learner success, few reported reading articles or wanting an opportunity to learn how to help adult learners to be more successful. Lack of time and effort seemed to be factors in preventing the faculty from developing teaching skills and supportive strategies.

Dudley et al. (2015) compared faculty and student perspectives on the level of student engagement, expectations of faculty feedback, and standards by conducting a qualitative case study. Their study differs from this study in the following ways: the study is quantitative, and this study focused on supportive strategies inside and outside of the classroom as reported by both faculty and students in community college. The study conducted by Dudley et al. (2015) did not address the supportive faculty strategies inside and outside of the classroom.

The study by Dudley et al. (2015) took place at a community college in Los Angeles where they regularly administered two surveys: the Community College Survey

of Student Engagement and the Community College Faculty Survey of Student Engagement. From survey results, the researchers identified themes surrounding active and collaborative learning as well as student-faculty interactions. The themes were the foundation for the questions asked in nine focus group interviews consisting of 63 students.

Dudley et al. (2015) found that students valued higher expectations from faculty members and challenging coursework. Students reported feeling the need to work harder when the coursework was of greater difficulty. However, these same students reported sometimes not taking advantage of support services on campus to ensure successful outcomes, despite recognizing their need to exert greater effort in a more challenging class. Students also reported feeling high expectations from their faculty. They expressed wanting timely, detailed, and constructive feedback from faculty members within at least a few days after turning in material. They also expressed wanting email responses within 1 to 2 days. Finally, these students valued having a passionate and caring instructor and remarked that a faculty member with those characteristics would be able to create a comfortable learning environment.

According to Dudley et al. (2015), students recognized that a lack of preparedness would cause a lack of participation in class, and some students reported only putting enough effort in to pass a class. In other words, students reported the level of effort they expended was adjusted to be just enough to satisfy the requirements set by the faculty member. Given that 62% of the students surveyed worked off campus and about one-third provided care for parents, children, or spouses, Dudley et al. (2015) posited that

time constraints may have prevented these students from going above the bare minimum of what was expected from their instructors.

The studies in this section were seeking to learn more about the alignment of supportive faculty strategies with students' expectations of faculty within the developmental classroom. By understanding student and faculty perspectives on learning barriers and factors that contribute to a student's successful outcome, community colleges could develop improved pedagogical and institutional practices. The studies were designed to learn more about students and faculty doing so from each group's own perspective. The qualitative study conducted by Dudley et al. (2015) was the only study to examine the relationship between faculty and students on engagement and feedback, but it did not focus on faculty and students in developmental mathematics courses in community colleges.

Given the lack of research on students enrolled in and faculty teaching developmental mathematics programs, this study addressed the gap in the literature by comparing faculty and student reports on the importance and existence of supportive faculty strategies in community college developmental mathematics classrooms. This study analyzed survey results to determine if there was a correlation between which supportive factors faculty indicated were practiced and which supportive factors students reported they needed to be successful. The direct comparison of both groups by means of a quantitative study informed the research and contribute to the body of literature.

## **Chapter Summary**

Through the analysis of research conducted within the past two decades, Chapter 2 began with a description of the history and definition of validation theory to help frame this study and demonstrate its importance. Next, this chapter provided information on the impact of learning communities on nontraditional students. The research helped to identify key components of learning communities that students described as being advantageous to their college experience. Validating elements were seen in the examination of the learning communities providing further emphasis on the need to explore the impact of supportive strategies in alternative settings. Finally, the chapter concluded with a section describing the studies aimed at understanding the barriers to student learning from both faculty and student perspectives, respectively, as well as student perceptions on what faculty can do to contribute to their successful outcomes. Chapter 3 provides a thorough description of the methodology for conducting this study by describing the research context, the participants, the instruments used in data collection, and the procedures for data collection and analysis.

## **Chapter 3: Research Design Methodology**

### **Introduction**

More than half of the students entering community colleges are not ready for college-level courses (Melguizo et al., 2014). Such students are subsequently testing into developmental-level courses where the greatest enrollment is in developmental mathematics sequences (Bahr, 2011; Le, et al., 2011). Students enrolled in developmental courses tend to be nontraditional, generally have full- or part-time jobs, or they have families they are responsible for outside of their academic responsibilities (Bahr, 2011; Rendón, 1995; Scott-Clayton & Rodriguez, 2012). As such, they have significant time constraints that prevent them from being involved in non-academic activities. To facilitate a sense of belonging and to enhance the college experience for these students, faculty should employ supportive strategies such as validation of students both academically and interpersonally (Acevedo-Gil et al., 2015; Barnett, 2011; Rendón, 1994, 2002). Studies have shown that when faculty validate their students and involve them in the learning process, students have a more positive outlook on their college experience and tend to persist longer than those who are in non-supportive developmental courses (Acevedo-Gil et al., 2015; Barnett, 2011; Colorado-Burt, 2015; Garcia, 2015). When students are in more supportive environments, they are more likely to persist and complete course sequences to reach college-level proficiency, which translates to degree completion. This study sought to understand more about the existence and importance of



supportive faculty strategies on students in developmental mathematics classrooms as well as those supportive strategies in evidence outside of the classroom.

The research design for this study employed quantitative methods for analyzing the relationship between student and faculty with self-reported supportive factors experienced at two different institutions. The following research questions guided the study:

- 1a. What supportive factors are incorporated in classrooms as reported by *students* in developmental mathematics classrooms?
- 1b. What supportive factors are incorporated in classrooms as reported by *faculty* who have taught developmental mathematics?
- 2a. What supportive factors are incorporated outside the classroom as reported by *students* in developmental mathematics classrooms?
- 2b. What supportive factors are incorporated outside the classroom as reported by *faculty* who have taught developmental mathematics?

These self-reports were based on experiences within developmental mathematics classrooms as well as outside the developmental mathematics classroom. By surveying both faculty and students, information regarding the comparison of the two groups was collected to provide insight into which supportive strategies faculty employed that students reported experiencing or reported a need to be successful.

### **Research Context**

The study surveyed faculty and students from two community colleges in upstate New York. To understand more about the supportive factors as reported by students and faculty, the researcher collected data from the population of developmental mathematics

students as well as from mathematics faculty from both institutions. The two community colleges involved in the study varied in size as well as by institutional practice. One institutional practice that differed between the two institutions is that math placement testing occurred only at the larger institution, whereas high school transcripts primarily indicated math-level placement at the smaller institution. The first institution was a large, urban community college with a recorded enrollment of 14,586 students for the fall semester of 2015 with 307 full-time faculty and 792 part-time or adjunct faculty. For the purposes of this study, the first college is known as Urban Community College (UCC). The second institution was a small, rural community college with a recorded enrollment of 6,761 students for the fall semester of 2015 with 116 full-time faculty and 263 part-time or adjunct faculty. For the purposes of this study, the second college is known as Rural Community College (RCC). Both schools had transfer opportunities to other colleges and universities through 2 + 2 programs, and both offered a variety of certification programs.

### **Research Participants**

Purposive sampling was used to select the student population relevant to the study: those students enrolled in developmental mathematics courses. According to Singleton and Straits (2005), “in this form of sampling, the investigator relies on his or her expert judgment to select units that are ‘representative’ or ‘typical’ of the population” (p. 133). Course format plays a role in purposive sampling because students in face-to-face and flexible-pace sections were surveyed. Flexible pace is a type of learning format that consists of mastery by learning via computer modules that students complete at their own pace in a classroom setting. Any students in online sections were not included in the

study to focus on in-person learning formats. Each instructor was asked to self-identify, via an initial survey question, whether he or she had ever taught a developmental math course. If that instructor indicated never teaching a developmental math course, then that particular survey was closed.

Both UCC and RCC varied in student population. UCC enrolled 32,841 students in credit and non-credit courses, combined, with 53% female and 47% male enrollment. Approximately 37% of the students were minorities, and 33% of the student population was aged 25 or older. RCC enrolled 6,761 full- and part-time students with 58% female and 42% male. Approximately 30% of the students enrolled at RCC were minorities.

To provide an understanding of the quantity of students who were potential respondents of the study, the fall 2015 semester student enrollment at UCC was: 707 enrolled in elementary algebra, 216 enrolled in algebra for statistics, and 1,145 enrolled in intermediate algebra. The fall 2015 semester student enrollment at RCC was: 87 enrolled in fundamentals of mathematics and algebra skills, and 128 enrolled in intermediate algebra. The courses were considered developmental because they were prerequisites for college-level mathematics courses.

In terms of faculty statistics, RCC employed 10 full-time mathematics faculty and 25 adjunct faculty members. UCC employed 37 full-time mathematics faculty and 72 adjunct faculty members. These faculty members were solicited to participate in the survey and asked to self-identify teaching at least one developmental course. They were asked to reflect on that experience by answering the survey questions.

## **Instruments and Process Used in Data Collection**

Two surveys were developed and adapted from the College Experience Survey, which was validated as a reliable tool for measuring faculty validation (Barnett, 2011). “Validation theory provides a framework that faculty and staff can employ to work with students in a way that gives them agency, affirmation, self-worth, and liberation from past invalidation” (Linares & Muñoz, 2011, p. 17). The survey assessed the extent to which faculty behaved in a supportive manner consistent with the six elements of validation as described by the theory (Rendón, 1994). One of the surveys was administered to students in developmental mathematics courses at both colleges (Appendix A), and the other survey was administered to math faculty from both colleges (Appendix B). The researcher was granted permission by Elizabeth Barnett, the developer of the survey, to use the instrument for this study (Appendix C).

Qualtrics, a survey design and analysis software program, was used to create an electronic version of the surveys used for this study. According to McPeake, Bateson, and O’Neill (2014), electronic surveys offer advantages that traditional surveys do not by reduction in costs and ease of analysis. The drawbacks include selection bias or poor response rate. To help counteract the drawbacks, McPeake et al. (2014) recommended personalizing emails to make them more engaging, having a link to a survey that is easily accessible, and being honest about the length of the survey or how long it might take to complete.

The questions from the survey were manually inputted into the program with 6-point Likert scales ranging from either *Very Strongly Disagree* to *Very Strongly Agree* followed by a section with 4-point Likert scales ranging from *Never* to *Always*. Following

the Likert scale questions, there were various questions requesting academic background information, college enrollment information, and demographics. The adapted surveys were designed in this manner to closely parallel the Classroom Experience Survey created by Barnett (2011). There was a progress bar at the bottom of the survey, providing an indication of the length of the survey as it was being taken. The survey was formatted in Qualtrics so that minimal scrolling of text was needed to complete the survey. The recipients clicked on the *next* icon each time they completed a series of questions that were framed to fit the screen.

The first phase of taking the survey requested informed consent from the faculty members. Following informed consent, the faculty members were asked to self-identify whether he or she taught one of the developmental math courses being used for the study. If the response was no, the survey ended, and the faculty member was thanked for his or her time. If the response was yes, the faculty member could take the survey in its entirety. Similarly, following informed consent, the students began by indicating which course they were enrolled in for the spring 2016 semester and were able to progress through the rest of the survey as designed. The course selection was important so that the researcher was aware of that responses were being generated by one of the institutions, UCC or RCC. The math courses with the prefix MTH were courses taken at UCC, and the courses with prefix MAT were courses taken at RCC. The last section of the survey requested demographic information.

The Qualtrics program was used to send reminder emails (Appendix D) to the students and faculty throughout the time the survey was accessible, and it was also used to send thank you emails to those who completed the survey (Appendix E). The survey

was accessible for three weeks, with reminders at the beginning of Week 2, the beginning of Week 3, and the day prior to survey end date. Despite having a low percentage of students complete the survey, there were 155 UCC student respondents and only eight RCC student respondents.

To increase the RCC student response rate, the survey was reopened with small gift card incentives to the vendor of the students' choice to the first and second 25, respectively. This boosted the number of responses from eight students to a total of 31 students. The survey incentive was only offered to the RCC students and was available for just 2 weeks. A reminder was sent at the beginning of Week 2 and the day before the survey closing date. Once the data were collected and the email addresses removed from the responses, the data were analyzed using SPSS software.

### **Data Analysis**

The research study was reviewed by the Institutional Review Boards from three institutions: UCC, RCC, and the 4-year institution where the researcher was a student. Upon approval, emails were sent to the math department faculty at the two community colleges, inviting them to participate in the survey (Appendix F). In addition to providing a link to the survey, the email explained the intent of the study, the confidentiality of the responses, and the importance of providing consent.

At the time of the preparation of the study, the researcher was a faculty member at UCC and did not have access to the students at RCC; therefore, permission was requested of the RCC Provost as well as the Chair of the Mathematics Department for help in administering the surveys on their campuses. The students and faculty were informed that they could take the survey on a computer, tablet, or smart phone device. By providing

this information, the researcher hoped to elicit a sense of comfort from the both groups, assuring them that only a small effort was required to fill out the survey and that it could be completed anywhere they had an Internet connection. Once the survey was completed, a follow-up email was sent, thanking the participants for their time and effort.

**Analysis of student data.** The study employed a cross-sectional research design (Creswell, 2014). When sufficient data were collected, the researcher tested for normality and found the data were approximately normal. The researcher then conducted an analysis of variance (ANOVA) to test for differences between students and faculty on each of the four subconstructs, as defined by Barnett (2001). The four subconstructs: *students feeling known and valued, caring instruction, appreciation for diversity, and mentoring*, and their associated survey items are listed in Appendix G. In addition, the researcher conducted analyses on survey items related to *sense of belonging, intent to persist*, and *feelings of competence*, which are listed in Appendix H.

Multiple linear regression models were created to determine the significance and impact that each of the four subconstructs has on *sense of belonging, intent to persist*, and *feeling of competence*. Creswell (2014) explained that using multiple linear regression models would be appropriate to relate variables with a normal distribution. Multiple linear regression describes the relationship between several predictor variables and an outcome variable (Creswell, 2014). The predictor variables are the four subconstructs of supportive faculty strategies, and the impact on students, through their sense of belonging, intent to persist, and feelings of competence, are the outcome variables in question. Lastly, a binary logistic regression was performed to determine if the four

subconstructs influenced a relationship between the students and their desire to pursue STEM careers.

**Analysis of faculty data.** Similar to the student data, the data collected from the math faculty were found to be approximately normal. The researcher then conducted an analysis of variance (ANOVA) to test for differences between students and faculty on each of the four subconstructs. Descriptive statistics were calculated for each of the subconstructs to allow for a comparison between the faculty data and the student data. A Pearson correlation matrix was created to determine the existence of a relationship between (a) number of years teaching and each of the four subconstructs, and (b) number of assigned credit hours and each of the four subconstructs. Finally, an ANOVA was conducted to compare faculty versus student roles on each of the four subconstructs to determine any significant differences between responses from both populations. The data was not paired because the students were not asked to identify their individual instructors.

**Analysis of open-ended questions.** The student respondents in the study were asked open-ended survey questions regarding placement testing and knowledge of STEM career pathways. The faculty respondents were asked open-ended survey questions regarding ways to respond to the diverse academic backgrounds of students and their opinion of the placement testing at their respective colleges. The open-ended responses from both groups were coded for themes using conventional content analysis (Hsieh & Shannon, 2005), and then frequency of occurrence was obtained for each theme.

By analyzing the data using ANOVA, multiple linear regression models, and descriptive statistics, the researcher attempted to answer the research questions posed for this study. The data were analyzed from both the faculty and student perspectives to



compare their responses and identify the existence and importance of supportive strategies inside and outside of the classroom. The information collected helped to give a better understanding of the supportive strategies that were important to students, and which strategies the faculty members felt were important to their pedagogical practice.

### **Researcher Qualifications**

At the time of this publication, the researcher was employed as a full-time mathematics instructor at UCC. The researcher had access to the student population, had established relationships with the mathematics faculty, and was considered to have expert judgment on selection of the population at UCC. The researcher holds a B.S. and an M.S. in Applied Mathematics along with 9 years of experience in higher education. The researcher has extensive knowledge of various pedagogical practices for teaching in the developmental mathematics field and was directly involved in the successful implementation of an accelerated, modularized Pathway to Statistics at UCC.

### **Confidentiality**

All the data collected from the surveys were secured in a password-protected data file to which only the researcher had access. The anonymity of the respondents was ensured by Qualtrics as the software has a feature that removes panel information and IP addresses from the collected responses. This feature made it possible for the researcher to analyze data from any of the student respondents all while ensuring their anonymity. Since the surveys were not linked specifically to a respondent, the researcher was unable to determine which surveys were completed by which respondent. The email addresses provided by the respondents for entering the raffle were removed prior to analysis of the data. This further ensured that the researcher was unable to identify each respondent. The

winners received an email with an electronic gift card to prevent a possible breach of anonymity that could result from an in-person pick-up location.

### **Research Procedures**

To carry out the study, the following steps were taken:

1. Institutional Review Board forms for expedited review were submitted and approved by the two community colleges and the 4-year research institution.
2. The College Experience Survey was adapted in Qualtrics as two separate surveys, one for faculty and one for students.
3. The surveys were pilot tested with a faculty member and a student to ensure clarity and to determine the length of time needed to complete the surveys.
4. The researcher sent an email to the Provost and Chair of the Math Department at RCC requesting support and assistance in administering the survey, respectively.
5. Qualtrics was used to administer emails containing a link to the electronic survey, inviting faculty and students to participate.
6. Once opened, the surveys remained active for a period of 3 weeks, with the second batch of surveys remaining open for 2 weeks.
7. During the second round of surveying, personal email addresses were provided to the researcher by a representative from RCC to reach students during the summer semester.
8. To increase RCC student response rates during the second round of surveying, faculty who taught developmental math during the spring 2016 semester were asked to email their students to encourage them to take the survey.

9. Once the data was collected from both rounds of surveying, the list of email addresses provided by the respondents was removed from the data prior to conducting the analysis. These email addresses were not linked to the surveys taken to ensure confidentiality.
10. Upon removal of email addresses, four respondents from the pool of email addresses were randomly selected as winners of the raffle. Each of the winners received an electronic gift card delivered to their indicated email address.
11. With the second round of incentives provided to RCC students, a total of 17 respondents requested the gift card out of the 24 students who completed the survey.
12. All data collected via Qualtrics will continue to be maintained on a password-protected computer for a maximum of 3 years from the date of this publication. After that time, the data will be deleted.
13. The data was analyzed using SPSS software.
14. The anecdotal data was analyzed by coding for themes and then organized by frequency of occurrence.

### **Chapter Summary**

Chapter 3 provided a description of the research methods that were used to conduct this study, beginning with a reintroduction of the study along with the research questions. The study took place at two community colleges in Upstate New York with math faculty and students in developmental math courses as the research participants. The College Experience Survey was adapted to survey the faculty and the students on

their reports of supportive faculty strategies. The Math Faculty Experience Survey consisted of 40 questions regarding supportive factors, diversity of academic backgrounds of students, teaching workload, placement testing, as well as demographics. The Developmental Mathematics Experience Survey consisted of 61 questions regarding supportive faculty strategies, description of placement process, understanding of middle-skill employment opportunities, college enrollment information, and demographics. The responses of the survey were analyzed using descriptive statistics, a bivariate correlation matrix, multiple linear regression, and ANOVA. The open-ended responses were coded for themes using conventional content analysis and organized based on frequency of occurrence of each theme. The confidentiality of the respondents was ensured by noting that the statistical software had features that removed all identifying data. Lastly, the chapter contained a section on research procedures, including obtaining IRB permission, pilot testing, emailing surveys to UCC and RCC, introducing a second round of surveying to capture more student data, as well as removal of email addresses prior to the analysis of data.

## Chapter 4: Results

### Introduction

The purpose of this study was to identify strategies supportive of students inside and outside of developmental mathematics classrooms. Mathematics faculty and students in developmental mathematics classrooms were surveyed using an adaptation of the College Experience Survey (Barnett, 2011). With validation theory as the lens, the researcher focused on populations from both UCC, a large, urban community college, and RCC, a small, rural community college. Validation theory was used because of its focus on the nontraditional student and the importance of understanding how to best support and motivate these students toward successful outcomes (Rendón, 1994). Because nontraditional students are increasingly enrolling in community colleges (Bailey et al., 2010; Lundberg, 2010), it is important to explore the supportive factors that might help nontraditional students persist and obtain credentials.

### Research Questions

The research design for this study employed quantitative and qualitative methods for analyzing the relationship between student and self-reported supportive faculty strategies experienced at two different institutions. The following research questions guided the study:

- 1a. What supportive factors are incorporated in classrooms as reported by *students* in developmental mathematics classrooms?

- 1b. What supportive factors are incorporated in classrooms as reported by *faculty* who have taught developmental mathematics?
- 2a. What supportive factors are incorporated outside the classroom as reported by *students* in developmental mathematics classrooms?
- 2b. What supportive factors are incorporated outside the classroom as reported by *faculty* who have taught developmental mathematics?

### **Data Analysis and Findings**

The study focused on the math faculty population and the population of students in developmental mathematics from both UCC and RCC. Demographics and descriptive statistics are reported for each group to provide an understanding of the makeup of the surveyed population. Several ANOVAs were conducted to compare means and determine if the student data and the faculty data differed significantly. A linear regression model was created to examine the ability of the four subconstructs of faculty validation, as defined by Barnett (2011): *students feeling known and valued*, *caring instruction*, *appreciation for diversity*, and *mentoring*, to significantly predict *sense of belonging*, *competence*, and *persistence*. Lastly, the anecdotal data were coded for themes using conventional content analysis and organized based on frequency of occurrence of themes.

Using validation theory, Rendón and Jalomo (1995) defined the characteristics of a validating classroom environment and a therapeutic learning community. In a similar approach, the researcher mined the data from this study to examine supportive factors inside and outside of the classroom. The analysis was structured to examine the behaviors reported by both the students in the community college developmental mathematics

classrooms and the mathematics faculty who were teaching the developmental mathematics courses.

**Data screening.** Prior to analyzing the data, the researcher screened the data to determine if parametric or non-parametric tests would be used. For the analysis of variance, the independent variables were categorical, and the dependent variables were scaled. Because ANOVA and multiple linear regression both assume the dependent (or outcome) variables are normally distributed, skew and kurtosis were examined, and the dependent variables were found to be within acceptable limits. Levene's test of equality of error variances was used to check the assumption that the groups had equal variances. All of the Levene's tests were not significant; therefore, this indicated that the assumption was met and no corrections were needed.

**Demographics.** The student sample for the two community colleges combined included almost half (45%) of participants who identified as White and approximately a quarter (26%) who identified as being a member of a racial minority. It is important to note that almost one-third (29%) of the students surveyed in the study chose not to identify their racial/ethnic identity. Additionally, almost three-fourths (71%) of the students represented in the sample were female.

This sample was representative of the population of all students in developmental mathematics classrooms from both community colleges as approximately half (51%) of students identified as White. Almost half (48%) of the student population identified as being a member of a racial minority with a very small proportion (less than 1%) of students choosing not to identify their racial/ethnic identity. Lastly, approximately 53% of the students in the population were female.

The faculty sample for the two community colleges, combined, included almost three-fourths (71%) who identified as White, with a very small proportion (8%) of the faculty who identified as being a member of a racial/ethnic minority. It is important to note that approximately one-fifth (21%) of the faculty chose not to identify their racial/ethnic identity. Additionally, the majority of faculty (60%) represented in the sample were female. The demographics for the student sample and faculty sample are presented in Table 4.1.

Table 4.1

*Student and Faculty Demographics*

Demographics	Student		Faculty	
	<i>n</i>	%	<i>n</i>	%
<b>Race/Ethnicity</b>				
White	84	44.9%	47	71.2%
Black or African American	26	13.9%	4	7.3%
Hispanic	17	9.1%	0	0.0%
Asian	4	2.1%	1	1.5%
Amer. Indian/Native Amer.	1	0.5%	0	0.0%
Preferred not to answer	55	29.4%	14	21.2%
<b>Gender</b>				
Female	99	71.2%	32	60.4%
Male	40	28.8%	21	39.6%



## Research Question 1

The researcher used descriptive statistics, analysis of variance, and Pearson correlation to examine the first set of research questions:

- 1a. What supportive factors are incorporated in classrooms as reported by *students* in developmental mathematics classrooms?
- 1b. What supportive factors are incorporated in classrooms as reported by faculty who have taught developmental mathematics?

**Descriptive statistics.** Based on the four subconstructs of faculty validation as defined by Barnett (2001): *students feeling known and valued*, *caring instruction*, *appreciation for diversity*, and *mentoring*, descriptive statistics for both the surveyed students and faculty were calculated. Table 4.2 shows the minimum and maximum scores, the mean, and the standard deviation for each subscale for students and for faculty. In examining the results, the mean score for *students feeling known and valued* was the highest as rated by the student population ( $M = 4.6$ ) and second highest for math faculty ( $M = 4.9$ ). The mean score for *caring instruction* was the lowest subconstruct reported by students ( $M = 4.2$ ), whereas the math faculty rated it as the highest ( $M = 5.0$ ). This difference represents a finding for the first set of research questions: there exists a discrepancy between the average ratings of the *caring instruction* subconstruct as a supportive factor from students and faculty within the mathematics classroom.

Table 4.2

*Descriptive Statistics for Students and Faculty by Subconstruct*

Subconstruct	Students				Faculty			
	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>
Students feeling known and valued	1.2	5.8	4.6	1.0	1.4	6.0	4.9	0.8
Mentoring	1.0	6.0	4.3	1.1	2.3	6.0	4.6	0.9
Appreciation for diversity	1.0	6.0	4.3	1.1	1.5	6.0	4.6	0.9
Caring instruction	1.4	5.1	4.2	0.8	3.3	6.0	5.0	0.6

**Analysis of variance by group.** The researcher conducted an ANOVA using the student data to compare the average rating for each subconstruct based on three categories: *ethnicity*, *nontraditional*, and *STEM*. The category *ethnicity* was based on separating the student sample into two subgroups where one group consisted of those who identified as being White and the other group as those who identified as being a member of a racial minority. *Nontraditional* status was defined as those students who were 25 years of age or older, as well as those students who were younger than 25 years old and caring for dependents (Kim, 2002). The category *STEM* comprised three subgroups: STEM majors, non-STEM majors, and undecided. Table 4.3 displays these results with calculated *F*-statistics, *p*-values, and effect sizes. The table shows that, based on the data from this study, there were no significant differences between ethnic breakdown, nontraditional status, and STEM affiliation on each of the four subconstructs. This means that, within the mathematics classroom, there was an absence of group

differences between ethnicity, nontraditional status, and STEM affiliation on *students feeling known and valued, caring instruction, appreciation for diversity, and mentoring.*

Table 4.3

*Group Differences for Students*

Dependent Variable		<i>F</i>	<i>P</i>	<i>n</i> <sup>2</sup>
Students feeling known and valued	Ethnicity	.26	.61	.00
	Nontraditional	.00	.99	.00
	STEM	1.87	.14	.03
Caring instruction	Ethnicity	.56	.46	.00
	Nontraditional	.01	.92	.00
	STEM	.98	.41	.02
Appreciation for diversity	Ethnicity	3.16	.08	.02
	Nontraditional	.66	.42	.01
	STEM	.46	.71	.01
Mentoring	Ethnicity	.08	.78	.00
	Nontraditional	1.01	.32	.01
	STEM	.83	.48	.02

Additionally, the researcher conducted an ANOVA using the faculty data to determine the significance of gender on each of the four subconstructs. As shown in Table 4.4, there were no statistically significant differences between gender groups. This implies that the data do not support making any claims that there are significant group differences between male and female mathematics instructors on *students feeling known and valued, caring instruction, appreciation for diversity, and mentoring.*

Table 4.4

*Group Differences for Faculty Based on Gender*

	Gender		
	<i>F</i>	<i>P</i>	<i>n</i> <sup>2</sup>
Students feeling known and valued	0.72	0.40	0.01
Caring instruction	1.91	0.17	0.04
Appreciation for diversity	0.90	0.35	0.02
Mentoring	0.30	0.59	0.01

**Pearson correlation using faculty data.** To determine if the length of time a faculty member was employed as an instructor at the community college, or if the number of credit hours assigned to the instructor had any relationship with each of the four subconstructs, Pearson correlations were calculated. As shown in Table 4.5, there was a weak, positive relationship between number of years teaching and *caring instruction*, as well as the number of assigned credit hours and *caring instruction*, each of which were statistically significant ( $r = .35, p = .01$ ;  $r = .30, p = .03$ ). Additionally, there was a weak, positive relationship between the number of years teaching and *appreciation for diversity*, which was statistically significant ( $r = .35, p = .01$ ).

According to the data, this represents a weak, statistically significant finding that faculty members rated themselves higher on the *caring instruction* as a supportive factor in the mathematics classroom the longer he or she had been an instructor as well as the more credit hours he or she had been assigned. Similarly, there existed a weak, statistically significant finding that faculty rate themselves higher on *appreciation for*

*diversity* as a supportive factor in the mathematics classroom the longer he or she has been teaching at the community college.

Table 4.5

*Pearson Correlations for Determining Relationship Between Years of Teaching Experience, and Number of Assigned Credit Hours, on Each of the Subconstructs*

	Years	Credit Hours
Students feeling known and valued	0.21	0.20
Caring instruction	0.35**	0.30*
Appreciation for diversity	0.35**	0.20
Mentoring	-0.03	0.11

*Note.* \* $p < .05$ ; \*\* $p < .01$

**Analysis of variance using combined faculty and student data.** The researcher performed researcher performed an ANOVA to compare the means of the students and faculty on each of the four subconstructs (Table 4.6). This analysis found a statistically significant result ( $F = 44.88, p < .001$ ) and revealed that 17% of the variance in means regarding *caring instruction* was accounted for by role: student versus faculty member. Faculty members rated themselves higher in *Caring Instruction* ( $M = 5.03$ ) than did the student population ( $M = 4.24$ ). This result confirms and statistically supports the initial finding (Table 4.2) that there exists a discrepancy between the student and faculty ratings of *caring instruction* as a supportive factor within the mathematics classroom.

The analysis also found statistically significant results showing that 2% of the variance in means regarding *students feeling known and valued* and *appreciation for diversity* was accounted for by role ( $F = 4.1, p < 0.05$ ;  $F = 5.30, p < 0.05$ ). However,

because the effect sizes were very small, the differences may not be practically significant.

Table 4.6

*Differences in Group Means Based on Role as Student versus Faculty on Each of the Subconstructs*

Dependent Variable	Role				
	$M_S$	$M_F$	$F$	$p$	$n^2$
Student feel known and valued	4.6	4.9	4.41	0.04	0.02
Caring instruction	4.2	5.0	44.80	0.00	0.17
Appreciation for diversity	4.3	4.6	5.30	0.02	0.02
Mentoring	4.2	4.6	3.63	0.06	0.02

*Note.*  $M_S$  = mean score for student data.  $M_F$  = mean score for faculty data.

To sum, in examining the student and faculty data for the purpose of answering the first set of research questions, it was found that there existed a statistically significant difference between the ratings of students and the ratings from faculty regarding *caring instruction* as an in-class supportive factor with the faculty rating themselves higher than the students rated the faculty. There was a weak, positive relationship between the longer a faculty member had been teaching and the rating for *caring instruction*, as well as the greater the number of credit hours assigned and the rating for *caring instruction*. Similarly, there was a weak, positive relationship between the longer a faculty member had been teaching and the rating for *appreciation for diversity* as a supportive factor within the classroom.

## Research Question 2

The researcher used multiple linear regression and conventional content analysis to examine the second set of research questions:

- 2a. What supportive factors are incorporated outside the classroom as reported by *students* in developmental mathematics classrooms?
- 2b. What supportive factors are incorporated outside the classroom as reported by *faculty* who have taught developmental mathematics?

**Linear regression models.** Multiple linear regression was used to analyze the ability of each of the four subconstructs of faculty validation to predict *sense of belonging, competence, and persistence*. This allowed the researcher to get a better sense of the impact that supportive factors had on students outside of the mathematics classroom. As shown in Table 4.7, the three separate linear regressions found that, together, the four subscales significantly predicted each of the outcome variables. Collectively, the four subconstructs accounted for 39% of the variance in *sense of belonging*, 40% of the variance in *competence*, and 50% of the variance in *persistence*.

Table 4.7

*Linear Regression Models Using Student Data to Determine Predictive Ability of the Four Subconstructs Collectively on the Outcome Variables*

Outcome Variable	<i>F</i>	<i>R</i> <sup>2</sup>
Sense of belonging	25.18*	.39
Competence	39.94*	.40
Persistence	26.27*	.50

Note. \**p* < 0.05

Further analysis of the linear regression models (Table 4.8) showed that *mentoring* was the only significant predictor of *sense of belonging*. *Appreciation for diversity* ( $\beta = 0.46$ ) and *students feeling known and valued* ( $\beta = 0.28$ ) both significantly predicted *competence*. *Mentoring* ( $\beta = 0.37$ ) and *students feeling known and valued* ( $\beta = 0.26$ ) were the strongest predictors of *persistence*.

Table 4.8

*Linear Regression Models Used to Determine the Predictive Ability of Each Subconstruct on Each Outcome Variable*

	Sense of Belonging			Competence			Persistence		
	$\beta$	$t$	$p$	$\beta$	$t$	$p$	$\beta$	$t$	$p$
Students feeling known and valued	-0.10	-0.51	0.61	0.28	2.33	0.02	0.26	1.99	0.05
Caring instruction	0.19	1.82	0.07	0.06	0.60	0.55	0.00	-0.06	0.95
Appreciation for diversity	0.08	0.85	0.40	0.46	5.13	0.00	0.08	0.82	0.42
Mentoring	0.49	4.55	0.00	-0.03	-0.32	0.75	0.37	3.54	0.00

These results indicate that if students feel like faculty know and value them, offer caring instruction, appreciate their diversity, and offer mentorship, the students are likely to feel a greater sense of belonging to the college, feel more competent as a college student, and have a greater desire to persist in their respective mathematics sequences. Using multiple linear regression, it was found that: (a) if faculty offers mentorship, students may feel a greater sense of belonging to the college community; (b) if faculty members appreciate diversity and make students feel known and valued, there is a greater chance that students will feel more competent; and (c) if faculty members mentor and



help students feel known and valued, then students are more likely to persist in their developmental mathematics sequences.

**Analysis of student open-ended responses.** To understand the supportive strategies incorporated outside of the developmental mathematics classroom, as reported by students, the researcher posed three sets of open-ended questions for students in developmental mathematics classes. The open-ended questions were items 45, 47, and 49 of the Developmental Mathematics Student Experience Survey:

45. Do you feel you were accurately placed in your current math course? If no, please explain why not.

47. Who gave you information about middle-skill jobs?

49. Was the information provided to you about middle-skill jobs the reason you are earning a STEM-related certificate or degree? Why or why not?

The researcher analyzed student data regarding open-ended responses to questions about accurate placement ( $n = 167$ ), source of middle-skill job information ( $n = 52$ ), and reasons for pursuing or declining to pursue a STEM-related degree ( $n = 93$ ).

The data showed that 21% of students ( $n = 35$ ) felt they were inaccurately placed in their respective math courses because of a lack of preparation due to inadequate review of material before taking the placement test or low perceived importance of the placement test. Only 3% ( $n = 5$ ) of the students who responded believed that the placement testing itself was faulty. The data showed that 79% of the students ( $n = 132$ ) felt they were accurately placed in their respective math courses.

Regarding identifying the source of information related to middle-skill employment opportunities, almost half (44.23%) of the students reported learning about

the information from an advisor or counselor. It should be noted that when students reported out on the source of middle-skill employment information, advisors fall into a separate category than do faculty members. Approximately a quarter (23%) of the students learned about middle-skill opportunities from college instructors, and almost one-third (33%) of the students learned about these opportunities outside of the college environment (Table 4.9). This is an indication that instructors were not reported as being engaged in helping students understand the middle-skill career opportunities available to them. Even though community colleges are the predominant source for degrees and certificates that allow students to gain middle-skill employment (Peterson et al., 2015; Stone et al., 2010), less than one-quarter of the students actually report ever hearing about middle-skill employment from a mathematics faculty member.

Table 4.9

*Source of Middle-Skill Employment Information as Reported by Students*

Source	Percent of Students ( <i>n</i> = 52)
Advisor/Counselor	44.23
Instructor	23.08
Previous knowledge	13.46
Unsure	9.62
Place of employment	7.69
Parents	1.92

Lastly, the researcher analyzed student responses relating to reasons for pursuing or declining to pursue a STEM-related degree (Table 4.10). According to the data, about

two-fifths (39.78%) of the students who responded indicated that they had no knowledge of STEM or did not understand what a STEM degree was when selecting their career paths. Approximately 34% of the students reported acquiring a STEM degree or certification based on personal or career interest, such as wanting a degree in nursing, engineering, dentistry, or radiology. Almost 26% of the students reported either having no interest in or were undecided about obtaining a STEM-related degree.

Table 4.10

*Student Reasons for Pursuing or Declining to Pursue a STEM-Related Degree*

Reason	Percent of Students ( <i>n</i> = 93)
Unaware of STEM-related degrees	39.78
Acquiring due to career/person interest	34.41
No interest	18.28
Undecided	7.53

These results show that the students were predominantly unaware of STEM-related degrees and were not provided STEM information prior to determining a career path. There exists a possibility that the students who reported having no interest or were undecided may have actually contributed to the percentage of students who were unfamiliar with STEM career opportunities. This indicates a lack of outside classroom support for students in the career-selection process. If students were not being made aware of these opportunities, then they would be unable to make an informed decision about possible career paths.

**Analysis of faculty open-ended responses.** To understand the supportive strategies incorporated outside of the developmental mathematics classroom as reported by faculty, the researcher posed two open-ended questions, items 33 and 37 on the Mathematics Faculty Experience Survey.

33. How can the college respond to the diverse academic backgrounds of the students?

37. What is your opinion of the mathematics placement process at this college?

The researcher analyzed the open-ended responses from the faculty at both institutions (Table 4.11) regarding the colleges' responses to diverse academic backgrounds of students ( $n = 41$ ), and regarding the faculty opinion of mathematics placement testing at their community college ( $n = 50$ ). Like the analysis of the student open-ended responses, the researcher used conventional content analysis and coded for themes to give meaning to the anecdotal data.

The most common theme reported by the mathematics faculty at both colleges was the notion of offering alternative pathways, including accurate placement into these pathways (46.34%), by addressing the diverse academic background of students. Faculty members reported needing a sorting system to accurately place students in math courses, such as using competency or standards based grading. Faculty also recommended offering multiple-course learning formats to respond to the varying learning modes for students in developmental mathematics classes, such as a flexible paced learning format, co-requisite offerings, and accelerated math sequences.

Table 4.11

*Themes on College's Response to the Diverse Academic Background of Students as Reported by Mathematics Faculty*

	Percent of Faculty
Response to Diverse Background Themes	(n = 41)
Alternative pathways and placement	46.34
Intervention	29.27
Mindfulness	17.07
College integration	9.76
Professional development	9.76
Satisfied or no answer	7.32

*Note.* Some faculty members' responses were coded into more than one theme.

The second most-common theme was applying an intervention (29.27%). Faculty members identified several intervention services that could be provided to students to promote academic success in college-level mathematics. The interventions mentioned included providing tutoring services, mentoring, advisement services, regular individual interaction with the instructor, and extra hours in class. Faculty also noted a greater need for transition classes to be offered in high schools aimed at preparing students for college-level readiness.

Mindfulness, which accounted for about 17.07% of the responses, included valuing students as people, asking questions differently or being more sensitive to language barriers, encouraging students to set realistic goals, and providing equal opportunities for students to respond to class discussion. Faculty members reported wanting to ensure that students did not feel excluded from class. Faculty did not want the

way in which they interacted with students to negatively impact the classroom learning environment.

Finally, both college integration and professional development ranked fourth in the list of themes, each with 9.76% of the responses. Culturally relevant clubs and activities for students were promoted by some faculty members. Other faculty members cited professional development for faculty as a necessary tool in responding to diverse backgrounds of students.

Regarding faculty giving their opinions about the mathematics placement testing at their respective colleges, Table 4.12 shows the emerging themes for responses ranked from highest to lowest. Approximately 58% of the faculty stated they were satisfied with their current mathematics placement processes at their respective colleges. Another 36% of faculty reported that the placement process needed improvement. They cited poor procedures and lack of flexibility as some concerns. Faculty believed that there should be more involvement from faculty and the department chair in facilitating placement of students, for example, by using a more holistic approach where students should be helped on a case-by-case basis. Another example was giving students an opportunity to test out of classes that they were placed in based on test results. Faculty felt that since students sometimes do not accurately prepare for the placement testing, they should be given an opportunity to test out of the class at the start of the semester.

Finally, like the student data, about 18% of the faculty stated that placement testing would be more effective if students were held more accountable for their math placement testing preparation. There were recommendations of encouraging students to review prior to taking the placement tests and informing students of the importance of the

test itself. Faculty members expressed the opinion that if students were given advance warning and more information about the importance of placement testing prior to taking the tests, they would be more likely to take the testing seriously and prepare accordingly.

The analysis produced a finding that both students and faculty shared common themes regarding the importance of, and properly preparing students prior to, taking a mathematics placement test. While most students and faculty believed the placement testing was sufficient, 18% of faculty and 21% of students believed some sort of outside classroom support would allow students to perform better on the placement tests. The responses of students and faculty cause the need to further explore mathematics placement practices.

Table 4.12

*Themes Associated with Math Faculty’s Opinion on Math Placement at College*

Opinions on Math Placement Process	Percent of Faculty ( <i>n</i> = 50)	Percent of Student ( <i>n</i> = 171)
Satisfied	58.00	79.00
Needs improvement	36.00	3.00
More accountability on students	18.00	21.00

*Note.* Some faculty and students responses were coded into more than one theme.

To sum, there were several findings that addressed the second set of research questions. As a whole, the four subconstructs significantly predicted each of the outcome variables: *sense of belonging*, *competence*, and *persistence*. More specifically, *sense of belonging* was predicted by *mentoring*, *competence* was predicted by *students feeling known and valued* and by *appreciation for diversity*, and *persistence* was predicted by *students feeling known and valued* and by *mentoring*. The students and faculty shared

common themes regarding the need for additional outside-of-the class support to help students perform better on their mathematics placement tests. The faculty was not a reliable source of information regarding middle-skill employment opportunities, and, generally, students were unaware of STEM and STEM-related degrees or certifications.

### **Summary of Results**

The researcher calculated descriptive statistics, conducted analyses of variance, performed multiple linear regressions, and used conventional content analysis to examine the data with the intention of answering the research questions. Several findings were made that describe the in-classroom and outside-of-the classroom supportive factors reported by students in developmental mathematics courses and reported by mathematics faculty members.

There was a significant discrepancy between the reported ratings of *caring instruction* by students and faculty, with students reporting at a lower rate. The data showed that the longer the faculty member was teaching at a college and the more credit hours assigned to that instructor, the higher the rating for *caring instruction* as an in-classroom supportive factor. Similarly, the longer the faculty member was teaching at a college, the higher the rating for *appreciation for diversity* as an in-classroom supportive factor.

Regarding outside-the-classroom support behaviors, it was found that the four subconstructs of faculty validation significantly predicted each of the outcome variables. Specifically, *Mentorship* significantly predicted *sense of belonging*; *appreciation for diversity* and *students feeling known and valued* led to greater feelings of *competence*; and *Mentorship* and *students feeling known and valued* predicted persistence. It was also



found that students and faculty agreed that there should be more outside-of-the-classroom supports in place to help students better prepare for the mathematics placement testing. Lastly, the data showed that faculty was not a main source of information regarding middle-skill employment, and students were dominantly unaware of such STEM-related opportunities at the community college. The next chapter contains an analysis of the findings and their implications, an explanation of the limitations of the study, a list of recommendations, and, finally, the conclusion.

## **Chapter 5: Discussion**

### **Introduction**

Among developmental reading, writing, and math, community college developmental mathematics course sequences have the highest failure rate (Bailey, 2009) with the highest enrollment rate (Bahr, 2011; Le et al., 2011). Research has also found that nontraditional students tend to enroll in developmental sequences due to various factors which prevent them from being prepared for college level mathematics (Bahr, 2011; Rendón, 1995; Scott-Clayton & Rodriguez, 2012). Such factors include needing to care for dependents, returning to college after a hiatus, being poorly prepared in secondary education, or having no example by which to look to in order to help navigate the college experience (Kim, 2002; National Center for Education Statistics, 1998; Rendón, 1994, 1995). By definition, a nontraditional student is one who comes from a low-income, working-class background, who may be a first-time, first-generation student, who may be aged 25 or older, or who may be financially responsible for dependents (Kim, 2002; Rendón, 2002). With various time constraints in place, it follows that nontraditional students tend to struggle through their college journeys (Linares & Muñoz, 2011; Rendón, 2002). Their life experiences and circumstances tend to limit the time available to place into their studies and to integrate into their academic experiences (Rendón, 2002; Terenzini et al., 1994). This limitation results in poor performances and, ultimately, results in higher rates of attrition. However, research shows that faculty can have a positive impact on nontraditional students in developmental sequences and that

supportive environments promote successful student outcomes (Barnett, 2011; Jehangir, 2009; Linares & Muñoz, 2011). With this in mind, the purpose of the study was to look at determining what supportive factors were being reported by students in developmental mathematics, and then examining what supportive factors were reported being incorporated in the pedagogy of mathematics faculty. More specifically, the goal of this study was to address the following research questions:

- 1a. What supportive factors are incorporated in classrooms as reported by *students* in developmental mathematics classrooms?
- 1b. What supportive factors are incorporated in classrooms as reported by *faculty* who have taught developmental mathematics?
- 2a. What supportive factors are incorporated outside the classroom as reported by *students* in developmental mathematics classrooms?
- 2b. What supportive factors are incorporated outside the classroom as reported by *faculty* who have taught developmental mathematics?

Guided by the research questions, the researcher adapted the College Experience Survey (Barnett, 2011) and ran various statistical tests on the collected data. The researcher used descriptive statistics to explore differences or similarities in ranked importance or existence of supportive factors: *students feeling known and valued, caring instruction, appreciation for diversity, and mentoring*. Several ANOVAs were used to compare means for students and for faculty on each of the four subconstructs, the aforementioned supportive factors. Pearson correlation and multiple linear regressions were used to identify if the subconstructs predicted student outcomes: *sense of belonging, competence, and persistence*. Lastly, the researcher used conventional content analysis to

examine the open-ended responses from students and from faculty to further identify the importance of supportive factors.

### **Implications of Findings**

Analysis of the collected data led to several findings which address the research questions and provide a clearer picture of the importance of supportive factors in and out of the classroom. The following four findings along with their respective statistical procedures are as follows: (a) through analysis of variance, there existed a statistically significant difference in mean ratings of *caring instruction* as a supportive factor in the classroom as reported by students and self-reported by faculty; (b) according to the descriptive statistics, students rated faculty lower than faculty rated themselves on *caring instruction* in the developmental mathematics classroom; (c) by calculating Pearson correlation, *caring instruction* and *appreciation for diversity* had a weak, positive correlation with the length of time a faculty member has been teaching at the college and the number of credit hours assigned to that faculty member; and (d) using a linear regression model, the four subconstructs as a unit significantly predicted each outcome variable with individual subconstructs predicting at higher rates than others.

In addition, through conventional content analysis of the open-ended responses, the researcher made the following three findings: (a) both students and faculty agreed there needed to be additional out of the classroom supports to help students perform better on the mathematics placement tests; (b) faculty did not provide information regarding middle-skill employment opportunities; and (c) students were generally unaware of STEM opportunities and STEM-related credentials.

***Caring instruction as rated by students versus faculty.*** The first two findings of the study showed that *caring instruction* was rated differently by mathematics faculty than by the students in the classrooms experiencing this supportive factor. Initially, the researcher calculated descriptive statistics to reveal that students were rating faculty at lower levels than faculty were rating themselves. An analysis of variance supported this finding showing that there was a statistically significant difference between student and faculty reporting of the *caring instruction* subconstruct. Because students were reporting at lower levels, it seemed to imply that faculty may have been inflating their self-reported scores. There appeared to be a disconnect between what faculty believed they are doing in the classroom and what students were actually experiencing. It is possible that the instruction provided by mathematics faculty is not perceived to be as caring as they might expect or intend. There may be pressure to get through curriculum which can sometimes be at the expense of the instructional environment. On the other hand, because mathematics courses have the lowest success rates (Bahr, 2011; Le, et al., 2011), students may already enter the class having low expectations and transfer that into the classroom experience. Therefore, even if the instructor is providing a caring environment, the difficulties associated by the course content may outweigh the instructor's efforts at implementing caring instruction.

Despite speculation of reasons for differences in reported values, research shows that there exists a lack of *caring instruction* in developmental courses (Acevedo-Gil et al., 2015; Zientek et al., 2014). Acevedo-Gil et al. (2015) discovered several instances of invalidating experiences in developmental mathematics classrooms. The data showed that mathematics instructors made students feel incompetent for asking questions related to

the material and, through poor pedagogical practices, made students feel academically invalidated. Zientek et al. (2014) conducted a study where they surveyed faculty members on reasons why they believe students are not successful in developmental mathematics courses. Among these reasons were that faculty believe students show a general lack of interest or effort, or may not see the value in learning mathematics. It is reasonable to deduce that a lack of support through *caring instruction* could deflate a student and make him or her feel disinterested or unmotivated which would then result in a lack of interest or effort.

**Impact of teaching duration and credit hour load on subconstructs.** While it was supported that *caring instruction* was reported differently by students than by faculty, the data also showed that the longer an instructor is employed by the college and the more credit hours assigned to that instructor, the higher the faculty rated importance of *caring instruction* in their pedagogical practice. The data showed there existed a weak, positive correlation between *caring instruction* and the length of time a faculty member has been teaching with the college and the number of credit hours assigned. Additionally, data showed that the greater the number of years of teaching experience, the greater the *appreciation for diversity*. These findings suggest that if faculty members have more experience teaching at the community college level and have more exposure to its diverse student body, then he or she may employ a more caring approach in the classroom and have a greater appreciation for that diversity.

Previous research proved similar findings. Austin-Hickey (2013) surveyed developmental mathematics faculty at Florida community colleges and found that there were significant, positive relationships between years of teaching experience and each of

the three types of organizational commitment: normative, sense of obligation to stay at the college; affective, affection for one's occupation; and continuance, the need to work for fear of loss of employment. It was also found that adjunct faculty, who are by definition assigned fewer credit hours at the college, had lower affective commitment than did the full-time faculty (Austin-Hickey, 2013). This research supports the finding that experience in the classroom, such as from being at the college for several years and from having higher numbers of credit hours assigned, may lead to more *caring instruction* in the classroom.

**Predictive ability of subconstructs on student outcomes.** After examining the relationship between a faculty member's longevity at the college and course load with each of the four subconstructs, the researcher used multiple linear regression to determine if the subconstructs as a whole and individually could predict student outcomes: *sense of belonging, competence, or persistence*. It was found that there was statistical significance in the ability of the four subconstructs taken together to predict an increase in each of the three outcome variable. Further analysis found that specific subconstructs significantly predicted specific outcomes (Figure 5.1).

Figure 5.1 shows that mentorship had the greatest predictive ability on *sense of belonging* and *persistence*. It is reasonable to conclude that as students are being guided and supported by faculty members, these students may feel as if they are an integral part of the college and may feel worthy of making the effort to succeed. These students may view the mentorship provided by faculty as a positive connection to the college experience and identify these faculty members as someone to hold them accountable for their actions. With this in mind, it is sensible to expect that a positive mentoring

relationship would encourage students to avoid disappointing their faculty mentors by making a greater effort in their college classes.

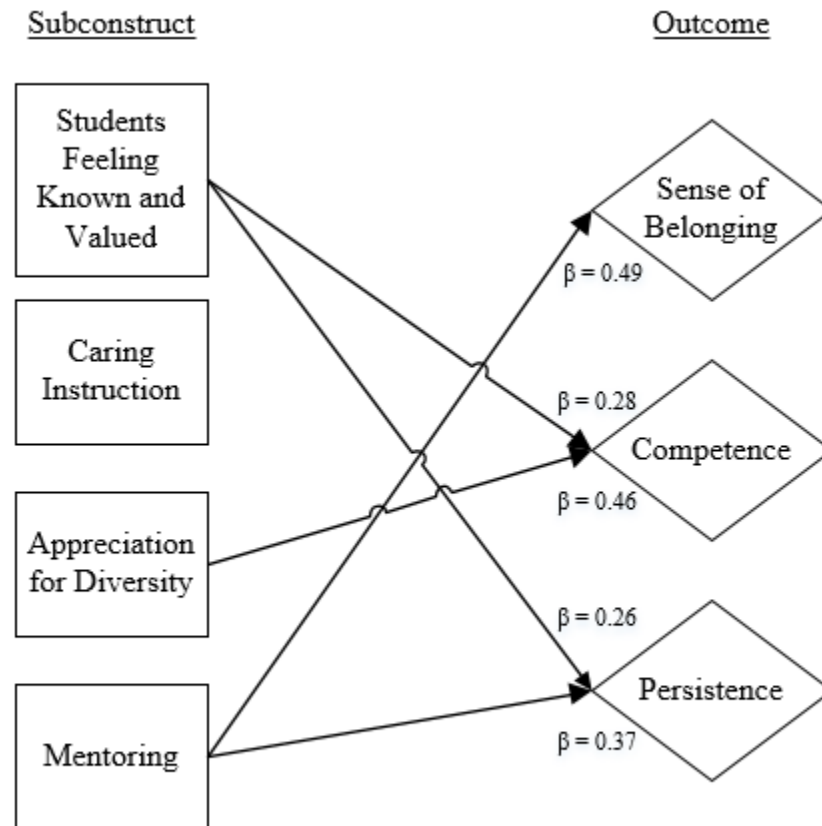


Figure 5.1. Multiple Linear Regression Analysis of the Four Subconstructs on Each of the Outcome Variables.

The idea that *mentoring* has predictive ability on *sense of belonging* and *persistence* is supported by research conducted by Rendón (2002) and Rendón et al. (2014). The researchers showed that when faculty become involved by bridging connections between students and the college experience, students tend to feel a greater *sense of belonging* and tend to perform better in class. The research conducted by Tinto (1999) supported this assertion through his finding that student integration, such as from



feeling a *sense of belonging*, is key to successful outcomes and degree obtainment. Therefore, it can be expected that increased faculty involvement through mentorship would increase a *sense of belonging* in students and help them to feel more integrated thus leading to higher rates of *persistence*.

Additionally, Figure 5.1 shows that *appreciation for diversity* had the highest predictive ability on *competence*. The data supported the finding that when faculty appreciate diversity in their students, a student's sense of *competence* increases. This indicates that if faculty recognize who their students are in a cultural context by making an effort to include the contributions of women and minorities in the curriculum, students may be able to connect to the curriculum itself and feel capable of learning the material. Conversely, if a faculty member shows disinterest in learning more about his or her students, it may cause the students to feel a lack of support which would in turn make students feel unmotivated and incompetent.

Lundberg (2010) and Rendón (2002) and found this to be true in their studies of Latino students in community college English classrooms and analysis of the College Student Experiences Questionnaire taken by students of color, respectively. Rendón (2002) found that Latino students felt more capable as learners when they were able to see themselves represented in the curriculum. As faculty designed more inclusive curriculum that supported their understanding of the diversity within their classrooms, students were made to feel more accepted and competent. Lundberg (2010) found that an institution's authentic value for diversity was the strongest predictor of general education learning, intellectual skills, and science and technology skills. Lundberg's research showed that minority students value institutions that embrace diversity.

It is also seen in Figure 5.1 that *students feeling known and valued* had predictive abilities on both *competence* and *persistence*. This indicates that when students are validated by faculty by being recognized and valued for who they are, they may feel like more capable learners and have a greater desire to prove this by persisting in their respective programs. This finding is supported by research which showed that students felt capable of learning when faculty validated those students by encouraging them and promoting ideas of the students' abilities to reach successful outcomes (Barnett, 2011; Colorado-Burt, 2015; Garcia, 2015; Lundberg, 2010; Nora, Kraemer, and Itzen, 1997). In fact, the study conducted by Barnett (2011) revealed the same finding that *students feeling known and valued* had a significant impact on *competence* and *persistence*. Colorado-Burt (2015) and Garcia (2015) found that when students in developmental courses experience academic and interpersonal validation from faculty, students tend to persist longer than those in non-supportive developmental classrooms. Lundberg (2010) revealed that the quality, not the quantity, of faculty-student interactions predicted gains in learning. Lastly, Nora et al. (1997) found similar results in that nontraditional, Hispanic students who felt support and encouragement and were satisfied with faculty and their instruction expressed a greater intent to persist. It is evident that in order for students to feel more competent and continue to persist in their education programs, faculty should understand how to effectively make students feel as if they are known and valued.

It should be noted that, while students rated faculty lower on *caring instruction* than did the faculty themselves, Figure 5.1 shows that *caring instruction* did not significantly predict any of the outcome variables. This differs from the qualitative study

conducted by Boulanger (2009) in which the researcher found that first-generation adult students' self-efficacy was important to persistence and was facilitated through positive college experiences. These college experiences include having caring mentors, effective teachers, as well as reinforcement of academic work. Though there is no statistical significance to *caring instruction* predicting *sense of belonging*, *competence*, or *persistence*, Boulanger (2009) showed that, at least qualitatively, having a caring instructor is a contributing factor to a positive college experience.

**Outside classroom supports for placement testing.** In order to set the foundation for an efficient and positive collegial experience, the study found that both mathematics faculty and students in developmental mathematics classes agree on the need for outside classroom academic supports in preparation for math placement testing. Both faculty and students felt that students were not committed to performing well on the placement tests due to being unaware of the impact of a poor performance. This can be interpreted to mean that there are few resources made available to the student prior to math placement testing. Students are not being warned of the importance of studying for the placement test, and review sessions are not being provided to these students to ensure accurate placement. This finding is directly supported by the research conducted by Goeller (2013) where, after surveying students in three developmental mathematics courses at a community college, found that, while most students felt they were accurately placed, “student responsibility emerged as a key component in increasing the effectiveness of the placement process” (p. 22). If students are made more aware of the importance of testing and are provided academic support to review material prior to

testing, it is a logical consequence that students will perform better and then be placed in the appropriate math class.

**Students are not informed of middle-skill opportunities.** The study showed that community college students were not learning about middle-skill opportunities, which would be attainable provided they earned a STEM-related certificate or degree, despite accuracy of placement in the appropriate math class. This study found that faculty members were not informing students, educating students, and sharing the breadth of middle-skill employment opportunities. Students reported learning about middle-skill opportunities from advisors or counselors, with less than a quarter of the students indicating that faculty was the main source of information. It should be noted that, in the study, faculty were not advisors at the two community colleges surveyed. Considering that nontraditional students spend most of their college experience within the classroom (Barnett, 2011; Rendón, 2002), faculty have ample opportunity to educate students on the importance and availability of middle-skill opportunities. Since faculty are not being reported as a source of information regarding middle-skill employment opportunities, it is possible that faculty are not fully informed on the opportunities themselves or knowledgeable of ways they can motivate students to earn credentials in a STEM related field. Faculty may not have the professional development needed to make them an accurate source of knowledge pertaining to middle-skill opportunities.

This finding is supported by a study conducted by Stone et al. (2010) where the researchers discovered that students were not being properly educated on the importance of a trained workforce qualified to fill the available middle-skill occupations. Researchers found that greater emphasis was placed on high-skill occupations which require a

Bachelor's degree or higher versus middle-skill occupations which are available to students with an Associate's degree. The researchers also found that students were not being informed of the income potential available to community college graduates acquiring middle-skill employment as being comparable, and sometimes better, than the income potential from having a four-year degree or higher.

**Students are not informed of STEM-related opportunities.** The lack of information regarding middle-skill opportunities contributes to the last finding of the study: students were unaware of STEM-related opportunities. The analysis of the open-ended responses showed that almost half of the students surveyed reported either not knowing about or were undecided as to whether or not they would pursue STEM-related opportunities. This can be interpreted to mean that students are not being educated by members of the college about the opportunities which might be available to them if they secure a STEM-related degree or certificate. Since a STEM-related certificate is needed to acquire middle-skill employment (Holzer & Lerman, 2007), then it would follow that students who were not aware of STEM-related credentials may not be aware of middle-skill employment opportunities. If community college faculty made students more cognizant of the potential for financial stability and job security as a result of securing middle-skill employment, then enrollment in STEM-related degrees may increase (Peterson et al., 2015). Research supports the findings from this study that (a) faculty did not play a significant role in the dissemination of knowledge to students regarding middle-skill employment available after completion of STEM-related degrees and certifications; and (b) students were generally unaware of STEM-related opportunities.

## **Limitations**

One of the limitations of this study was the lack of paired data. In order for the researcher to ensure confidentiality, the decision was made to avoid collecting paired data. Because students were not asked to identify their respective instructors, the researcher was unable to determine if the supportive strategies reported by each individual math instructor were similar to those reported by their respective students. Pairing students with their instructors may have allowed statistical methods to calculate the difference between the two sample means. This may have provided more concrete evidence regarding the reported supportive strategies inside and outside of the developmental mathematics classroom. However, it is possible that pairing the data may have also limited participation from students or from faculty. There may have been a greater hesitation to take the surveys knowing students and faculty would be linked in analysis for a more direct evaluation of each faculty member's supportive strategies.

While not being able to pair students with faculty contributes to the limitations of this study, so does survey fatigue. In a research project conducted by Porter, Whitcomb, and Weitzer (2004), it was found that multiple surveys administered during an academic year may significantly suppress response rates for later surveys. Survey fatigue is relevant to this study in that, by the time the researcher administered the Developmental Mathematics Student Experience Survey, students had already responded to several surveys given by institutional research throughout the academic year from both UCC and RCC. Therefore, the lower than expected response rates could very well be attributed to survey fatigue.

## **Recommendations for Future Research**

The study revealed two ways in which future research can be supported. The first recommendation for future research includes conducting a quantitative study that allows for the collection and analysis of paired student and faculty data. The second recommendation would be to conduct a qualitative study aimed at examining each subconstruct of faculty validation individually as reported by students and faculty.

**Quantitative research.** One of the limitations of the study was that student and faculty data were not paired prior to analysis. This limited the ability of the researcher to glean information about specific mathematics instructors' supportive strategies inside and outside of the developmental mathematics classroom and how it impacted their respective students. Having this paired data may help provide a clearer comparison of which supportive faculty strategies students report experiencing inside and outside of the classroom and how that aligns with the way in which their respective faculty members rate themselves on their implementation of those supportive strategies. The analysis of this paired data would provide more information as to how faculty are behaving with their own students inside and outside of the developmental mathematics classroom. This would in turn allow for a better understanding of the state of the community college in terms of what is needed for effectively supporting students in developmental mathematics courses. Having more information about what students are experiencing in their individual classrooms would allow for an awareness of any shortcomings and provide an opportunity to develop prescriptive measures to address these shortcomings.

In order to address any student or faculty concerns regarding pairing the data, it would be important to assure the respondents that only the researcher conducting the

study would have specific information related to each instructor and his or her class reports. It must be presented in a way that ensures confidentiality and ensures that the paired data would simply be used to help understand the prevalence of supportive factors by classroom and not by instructor. It is possible for an instructor to have two classes that report at different levels, so it would be useful to analyze each class individually and use this information to determine the scope of supportive strategies in developmental mathematics courses.

**Qualitative research.** A qualitative study should be conducted to examine the importance of each individual subconstruct from the perspectives of students in developmental mathematics courses and from mathematics faculty. Focus groups comprised of students in developmental math classes and focus groups comprised of mathematics faculty should be asked parallel questions to provide feedback on each of the four subconstructs: *students feeling known and valued*, *caring instruction*, *appreciation for diversity*, and *mentoring*. By using focus groups, the researcher would be able to elicit more descriptive and elaborate responses than what might typically be found as an open-ended survey response. This qualitative data could provide more in-depth information regarding the perceived importance of each subconstruct on the success of students in developmental mathematics classes.

### **Recommendations for Higher Education**

Each of the findings from the study uncover areas of need within the developmental mathematics arena. The following three recommendations for higher education institutions, 2-year and 4-year alike, take into consideration the importance of faculty, staff, and administrative involvement. The first recommendation is for college



administration to collaborate with faculty and staff on providing effective professional development designed to help faculty and staff understand how to create validating and supportive environments for students. The second recommendation is for the college to provide funding for review sessions in an effort to better prepare students prior to math placement testing. Lastly, it is recommended that the college provide funding for informational workshops designed to facilitate student and faculty collaboration. These workshops would provide faculty and student combined groups with in-depth information regarding STEM related opportunities and middle-skill employment availabilities.

**Professional development for faculty and staff.** The first recommendation is for community college administrators to provide faculty and staff with professional development intended to help facilitate a more inclusive and caring environment. According to the data analyzed in this study, it appears that math faculty believe they are providing caring instruction suitable for the diverse student population, when, in fact, the students in developmental math courses report significantly less support in the classroom. The data showed with statistical significance that students were reporting lower levels of *caring instruction* provided by faculty. Researchers have shown the benefits of promoting the practice of supportive strategies in developmental courses such as improved student satisfaction with course content, an increase in a student's sense of academic integration and involvement, and higher rates of persistence (Acevedo-Gil et al., 2015; Barnett, 2011; Colorado-Burt, 2015; Garcia, 2015; Lundberg, 2010). Research has also shown the positive impacts on minority students of valuing and emphasizing diversity as well as use of technology to drive learning (Lundberg, 2010). Since the research indicates the benefits of a supportive, inclusive environment regardless of discipline, it is

recommended that faculty from all disciplines and college staff be provided with ongoing professional development sessions that would educate them on the various supportive and technological strategies aimed at increasing learning for students in developmental courses.

Professional development sessions, funded by the college, would help to contribute to the college's strategic enrollment plans. The sessions should be held monthly for smaller groups of faculty and staff aimed at examining personal accounts of supportive strategies, while larger events aimed at exploring overall strategy and research should be held biannually. The first event would capture incoming faculty and staff at the beginning of the school year to emphasize the importance of integrating supportive strategies into pedagogy, and the second event would allow for group reflection and guidance on how to further implement supportive and inclusive practices. In the small group sessions, faculty and staff would be given the opportunity to elaborate on any preconceived notions regarding nontraditional students, to share personal experiences, and to collaborate on developing supportive strategies. More specifically, faculty and staff would be given the tools to effectively support nontraditional students inside and outside of the classroom. These tools include developing inclusive, student-centered curriculum that emphasizes on use of active learning and incorporation of technology based educational strategies; creating an open, honest, and reflective environment that continuously assures students of their ability to be college learners; accepting cultural and background differences among students and faculty; structuring opportunities for students to develop the skills needed to successfully navigate the college experience; having a willingness to mentor nontraditional students; and meeting with students at college

sponsored events such as athletic or performance events, and in common areas such as the cafeteria, tutoring centers, computer labs, and the library.

The importance of professional development is detailed by Baxter (2012) in his argument that “professional development sessions designed to expose faculty to culturally responsive teaching methods, group investigation and discovery models, or classroom learning communities can benefit instructors by providing them with research-based and innovative techniques to implement in their classes” (p. 138). Not only are faculty benefited by the techniques, but students are better supported in the classroom. The recommendation is that both faculty and staff be provided professional development to give them research-based tools to create a validating college experience for nontraditional students. This will, in turn, help nontraditional students to feel a greater sense of belonging, feel more competent, and be more likely to persist than those in an invalidating community.

**Review sessions prior to placement testing.** In addition to professional development, it is recommended that the college fund mathematics review sessions for incoming students prior to taking any math placement tests. One of the concerns that both faculty and students expressed in their comments on surveys for this study was that students are not being made aware of the importance of preparing for the math placement tests. Compounded with a lack of awareness is a lack of proficiency in math. With so many incoming students having poor mathematics foundations perpetuated throughout high school (Attewell, Lavin, Domina, & Levey, 2006; Bailey, 2009), it becomes incredibly important for community colleges to intervene and at least provide that up-front educational support. It may be advantageous for community colleges to require

these review sessions for students who have had a gap of time between the last math course taken and first year of college enrollment. This intervention may be all that is needed to bring a student one math class closer to college level readiness. Students would also be served by being accurately placed in alternative pathways offered by the college. Once students have completed the review session and then completed placement testing, college faculty and staff can assist students in being placed in the appropriate learning format whether it be online, flexible pace, accelerated, or traditional. By providing this educational support, the college would deliver the message that accurate placement is a significant priority and should also be a priority for the students.

**Informational workshops for students and faculty.** Besides providing review sessions for placement testing, it is recommended that the college establish workshops to teach both faculty and students about the continuously evolving middle-skill opportunities available to those with STEM-related degrees and certifications. Not only did student respondents in this study report faculty as not being a main source of information regarding middle-skill employment, these students also reported not having an understanding of STEM degrees and certifications. It is recommended that the college hold joint faculty and student workshops addressing these gaps with opportunities for field visits to STEM related facilities. Middle-skill opportunities continue to evolve with the latest advancements in technology and qualifying applicants continue to be in high demand for these middle-skill employment opportunities (Couturier, 2014). As such, it is important to continue educating faculty and students on the options that are available to those with a STEM related degree.

The benefits would be twofold: (a) faculty members would be provided with information that they can pass on to their respective classes while students would gain firsthand knowledge about potential career opportunities; and (b) both students and faculty would be involved in the learning process, not only to gain a better understanding about the opportunities provided through acquisition of STEM credentials, but to gain exposure to one another outside of the classroom. These workshops would provide a platform for collaborative learning between students and faculty, and serve the purpose of motivating students to reach their end goals: completion of degree and attainment of employment.

Furthermore, partnerships should be established with local middle-skill employers in the process of developing the curriculum for these workshops. Local employers and business leaders can offer insight into the qualifications they are looking for in potential employees, and then, through the workshops, faculty and students can learn about strategies needed to help students earn those qualifications. The Washington State Board for Community and Technical Colleges (2014) argued that “through high-impact business partnerships, two-year colleges track local and state job needs and respond quickly to meet critical labor market shortages” (p. 2). Building relationships with local employers and business leaders will help to guide the partnering colleges in understanding what is required to fill shortages in middle-skill markets. It is reasonable to expect that if students have a defined destination and have the support of the college and local employers to back them on their college journey, those students will be motivated to persist and earn credentials.

## **Conclusion**

Nontraditional students may be defined as individuals who are first-time, first generation college students, are age 25 or older, have full-time jobs, or are financially responsible for dependents (Kim, 2002; Rendón, 1994). This means that if nontraditional students want to further their education, they have to determine ways in which they can balance life responsibilities and maintain the financial burden associated with the opportunity costs of enrolling in college classes. One avenue that many nontraditional students take to alleviate some of that financial burden is to enroll in local community colleges (Bailey et al., 2010; Lundberg, 2010; Scott-Clayton & Rodriguez, 2012). However, these students are entering college ill-equipped for college-level courses. In fact, it is reported that as many as 60% of incoming community college students are testing into developmental course sequences rather than testing into college-level courses (Melguizo et al., 2014). More so than any other developmental sequence, developmental math has the highest enrollment rates with the lowest success rates (Bahr, 2011; Le et al., 2011). In an effort to try and increase success rates for those enrolled in developmental math sequences, research has found that colleges must address the needs of the nontraditional student by employing nontraditional supports.

Validation theory offers a lens in which to view and define nontraditional supports. Through an understanding of validation theory, research shows that nontraditional students benefit from quality interaction with and guidance from faculty members (Acevedo-Gil et al., 2015; Barnett, 2011; Rendón, 1994, 2002). Since most nontraditional students spend the majority of their time in the classroom as opposed to participating in any activities or college events due to time constraints (Linares & Muñoz,

2011), faculty play an integral role in bridging the gap between the student and successful outcomes.

With faculty being the main source of support for nontraditional students, the community college staff and administration become a secondary support system. Many community colleges require placement testing to determine in which math course a student will enroll upon acceptance to the college (Melguizo et al., 2014). Depending on where a student places in a math sequence, it could be several semesters, if not years, before he or she reaches college level math. Along with having to complete so many developmental courses in a sequence, so come financial constraints for the student. It is often the case that financial aid has limitations based on number of attempts at completing a course or number of courses in a given sequence (Bettinger et al., 2013). A student may only be allowed financial aid for a specific number of developmental courses or a specific number of attempts at each course. Essentially, both placement testing and financial aid can severely impact the ability of a nontraditional student to reach college level readiness let alone earn credentials.

If community college students are unable to reach college level readiness and complete their mathematics sequences, then they will be ineligible for acquiring a STEM-related degree or certificate. Those graduating from community college with STEM-related credentials would qualify for middle-skill employment (Holzer & Lerman, 2007). According to Gonzalez and Bozick (2016), it is projected the STEM economy will grow by 17% through 2018 and provide over two million jobs. With such a vast number of middle-skill jobs available, the potential for job security and financial stability could be realized by a student earning a community college degree. Success rates in

developmental math must be increased so that students can pursue and complete STEM-related college programs thus becoming eligible for middle-skill employment. If more nontraditional students are supported through their respective developmental math sequences, then they stand a better chance at secure a financially stable future for themselves and, more often than not, their families.

In order to support nontraditional students through their math sequences, research had to be conducted to determine what kinds of support these students required. After an extensive review of the literature, the researcher found that more information was needed with regard to examining both community college nontraditional students in developmental mathematics courses and mathematics faculty. As such, the purpose of this study was to understand what supportive factors were incorporated inside and outside of the classroom as reported by students and self-reported by faculty. The intention was to determine how to better serve the nontraditional students in an effort to increase retention and persistence rates.

With the goal of better serving nontraditional students, the literature review revealed that employing faculty validation (Acevedo-Gil et al., 2015; Barnett, 2011; Hester, 2011; Hurtado et al., 2011; Rendón, 2002; Terenzini et al., 1994), understanding student learning barriers (Brinthaupt & Eady, 2014; Capt & Oliver, 2012; Dudley et al., 2015; Ellerbe, 2015; Lundberg, 2010; Zientek et al., 2014), and implementing learning communities as supportive pedagogy (Engstrom, 2008; Jehangir, 2008; Wilmer, 2009) were all effective strategies aimed at increasing the success of nontraditional students. This literature review led the researcher to develop two parallel surveys adapted from the only validated and reliable survey which accurately assesses faculty validation: the



College Experience Survey (Barnett, 2011). The surveys were designed to address the facets of faculty supportive strategies and be answered from the perspective of math faculty and the perspective of students in developmental math.

Each survey was administered during the spring 2016 semester to the students in developmental mathematics courses and math faculty from two community colleges: UCC, a large, urban community college, and RCC, a small, rural community college. Several statistical tests were conducted to gain a better understanding of the supportive faculty strategies implemented inside and outside of the classroom. Descriptive statistics, analyses of variance, Pearson correlation, and multiple linear regression were calculated to learn more about supportive faculty strategies organized into four subconstructs (Barnett, 2011): *students feeling known and valued*, *caring instruction*, *appreciation for diversity*, and *mentoring*. These subconstructs were also used to determine predictive ability on student outcomes: *sense of belonging*, *competence*, and *persistence*.

The statistical tests revealed several findings. There existed a statistically significant difference in mean ratings of *caring instruction* as a supportive factor in the classroom as reported by students and self-reported by faculty; students rated faculty lower than faculty rated themselves on *caring instruction* in the developmental mathematics classroom. *Caring instruction* and *appreciation for diversity* had a weak, positive correlation with the length of time a faculty member has been teaching at the college and the number of credit hours assigned to that faculty member. The four subconstructs of faculty validation as a unit significantly predicted each outcome variable with individual subconstructs predicting at higher rates than others. In addition, through conventional content analysis of the open-ended responses, the researcher found that both

students and faculty agreed there needed to be additional out of the classroom supports to help students perform better on the mathematics placement tests. The researcher also found that faculty were not a main source of information regarding middle-skill employment opportunities, and students were generally unaware of STEM-related opportunities.

Based on the data analysis, there were two recommendations for future research and three recommendations for higher education. Regarding future research, a replication of the current study is needed that uses paired student and faculty data to analyze the importance and existence of supportive faculty strategies. Additionally, a qualitative study is needed to further explore the perspectives of each individual subconstruct as reported by students and faculty via focus groups.

In terms of recommendations for higher education, professional development for faculty and staff is needed. Faculty and staff would be provided with a platform in which they would learn about various inclusive and supportive strategies for inside and outside of the classroom through biannually campus-wide events and monthly small group sessions. Both groups would have an opportunity to not only satisfy any professional goals established by the college, but to contribute to the college's overall strategic enrollment plan.

It was also recommended that the college provide educational supports, such as review sessions, to help students prepare for math placement testing. Prior to any students taking placement tests, the college would provide review sessions to ensure students are aware of the material from which they will be tested. Students would then be guided by faculty or staff in determining the appropriate learning format that would suit their

individual academic needs. By providing funding and taking the time to ensure student preparation prior to testing, the college indicates that accurate mathematics placement is a valuable part of its strategic enrollment plan.

Lastly, it was recommended that colleges provide workshops aimed at combining faculty and students so that they can collaborate and learn more about STEM-related opportunities. The curriculum for these workshops will be based on information provided by local employers and business leaders affiliated with the middle-skill industry. The employers and leaders would provide up-to-date feedback on eligibility requirements for obtaining middle-skill employment. Students can then make a determination, based on accurate and current information, on whether or not they will pursue steps to gain middle-skill employment. Furthermore, allowing students to collaborate with faculty will inevitably motivate students to become more integrated into the college experience. If students and faculty engage one another in a collaborative setting, it is reasonable to expect that students would be more invested in their education. Additionally, if students have an end goal as a result of the education gained from the workshops as well as from field visits to STEM facilities, then it is also reasonable to expect that students will aim to see their goals come to fruition.

With faculty, staff, and administrators taking a greater role in the effort to improve retention and persistence rates, nontraditional students, who might otherwise not have an understanding of how to navigate the college experience, could have a chance at earning college credentials. Implementing strategies designed to increase rates of successful completion of developmental math will lead to a greater number of students reaching college-level readiness and, ultimately, motivate students to complete college.

Research has shown that developmental courses are comprised predominantly of nontraditional students, the majority of whom are minorities (Bahr, 2011; Rendon, 1995; Scott-Clayton & Rodriguez, 2012). With such a large representation of minorities in developmental courses, it is no surprise that minorities are severely underrepresented in the number of college graduates each year in the United States. This fact alone encourages organizations, such as Achieving the Dream and Jobs for the Future, to collaborate with policy makers on the creation of initiatives that work towards promoting minority enrollment and increasing the number of college graduates. Achieving the Dream Foundation and Jobs for the Future have partnered to create the STEM Regional Collaboratives Initiative in the fall of 2013 designed to provide support and technical assistance to colleges as they build highly structured middle-skill academic pathways, to improve partnerships between colleges and community leaders, and to foster continued learning and collaboration with other colleges (Couturier, 2014). Both Achieving the Dream and Jobs for the Future are committed to effect institutional change aimed at increasing success rates for underrepresented students. According to Couturier (2014), Achieving the Dream and Jobs for the Future argue that by successfully supporting minorities through retention, persistence, and completion of college credentials, there will be increased diversity in the workforce, increased representation of minorities in underrepresented fields, and a greater possibility for social change. Achieving the Dream focuses its priorities on influencing institutional change using evidence-based research, guiding change in public policy, increasing the depth and breadth of knowledge related to educating community college students, and determining ways to bridge communication with the general public (Couturier, 2014). Jobs for the Future focuses its efforts on

developing career pathways for college students while noting the importance of supporting students struggling to succeed due to barriers such as low-income status or inexperience due to being a first-time, first-generation student.

Amplifying the educated, minority presence in the workforce will allow for underrepresented groups to fight for equity in pay and in education reform, and to fight for legislation tailored to the needs of minority groups based on minority voice. Executive leaders in education, business, and technology should align strategies to help minority students successfully graduate from college with the skills needed to fill vacancies in high-need STEM related areas including the middle-skill workforce. By collaborating with one another, executive leaders can provide guided opportunities for college students to gain employment and earn financial stability. Successful attainment of credentials and employment by minorities will significantly change the landscape of the workforce by allowing minorities to be more visible and to use their voices to influence diversity practices. In 1957, James Baldwin, an African American novelist, playwright, poet, and spokesperson for the Civil Rights Movement wrote, “For while the tale of how we suffer, and how we are delighted, and how we may triumph is never new, it always must be heard. There isn’t any other tale to tell, it’s the only light we’ve got in all this darkness” (p. 438). Social change can only be guided towards equality if underrepresented groups share their stories and experiences while standing on the platform from which to be heard. Education is essential in promoting the opportunity for minorities to influence social change through exposure to the different cultures, by encouraging understanding of different customs and cultural practices, and, above all else, to promote acceptance.



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## **Appendix A**

### **Developmental Mathematics Student Experience Survey**

#### **Welcome to the Developmental Mathematics Experience Survey!**

##### **Informed Consent:**

Thank you for participating in this survey. Your honest feedback is important. The purpose of this survey is to gain a better understanding of the supportive behaviors inside and outside of the developmental mathematics classroom.

Your participation in this research study is voluntary. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. However, your participation is much appreciated and very valuable.

The online survey will take approximately fifteen minutes. Your responses are confidential and no identifying information such as your name, email address, or IP address will be collected. The survey poses minimal risk and poses no additional harm to participants than their routine daily activities.

All data is stored in a password protected electronic format. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The aggregate results of this study will be used for scholarly purposes only.

If you have any questions about the research study, please contact Rachel Santiago at (585) 292-2969. If you experience emotional or physical discomfort due to participation in this study, please contact the Health and Wellness Center at (585) 385-8280 for appropriate referrals.

The survey has been adapted from the College Experience Survey (Barnett, 2011).

The Institutional Review Board (IRB) of St. John Fisher College has reviewed this project. For any concerns regarding confidentiality, please call Jill Rathbun 585-385-8012. She will direct your call to a member of the IRB at St. John Fisher College.

**By clicking I DO CONSENT, PROCEED TO SURVEY you are verifying that you have read the above and give consent to participate in the study. You also agree that you are participating voluntarily.**

- I DO CONSENT, PROCEED TO SURVEY
- I DO NOT CONSENT

In which math course are you currently enrolled?

- MTH 096
- MTH 098
- MTH 104
- MAT 095
- MAT 097

**In the following section, a six-point scale is used from "Very Strongly Disagree" to "Very Strongly Agree."**

In my math course...

	Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree
1) My instructor helps me to believe in myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) I feel accepted as a person by my instructor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) My instructor has talked with me about my college goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) My instructor seems to genuinely care how I am doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) My instructor understands that students come from different backgrounds.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) My instructor is interested in what I have to offer in class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) I am encouraged by my instructor to openly share my questions and answers in class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) My instructor shows that (s)he believes in my ability to do classwork.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) My instructor knows who I am.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) My instructor is willing to take as long as needed to help me understand the class material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) I feel accepted as a capable student by my instructor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) My instructor makes me feel as though I bring valuable ideas to class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) I interact with my instructor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14) My instructor is willing to give me individual help when needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) Even if the work in my class is hard, I can learn it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In my math course...



	Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree
16) It seems like my instructor really cares about whether I am learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17) People from diverse backgrounds are encouraged to contribute to the class discussion.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18) If I have enough time, I can do a good job on all of my coursework.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19) I am encouraged to share life experiences when they relate to the class material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20) I can generally express my honest opinions in my class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21) My instructor provides written feedback on the assignments or tests I turn in.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22) I feel like my personal and family history is valued in class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23) Women and men are equally encouraged to contribute to class discussion.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24) I feel as though I am treated equally.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25) My instructor makes an effort to make the class interesting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26) My instructor encourages me and my classmates to become involved on campus.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27) My instructor usually remembers my name.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

With regard to the college in general...

	Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree
28) I see myself as part of the campus community.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29) I'm certain I can do almost all the work in college if I don't give up.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30) I'm certain I can master the skills taught at this college.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31) I am planning on returning to this college for the Fall 2016 semester.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32) I expect to complete a degree or certificate at this college.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33) I feel a sense of belonging to the campus community.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
34) I can do even the hardest coursework if I try.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35) I've had one or more instructors at this college whom I thought of as a mentor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**In the following section, a four-point scale is used from "Never" to "Always."**

In your experiences with your math instructor outside of class, how often have you done each of the following:

	Never	Sometimes	Very Often	Always
36) Used email to communicate with your instructor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
37) Discussed grades or assignments with your instructor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
38) Talked about career plans with your instructor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
39) Talked about Science, Technology, Math, and Engineering (STEM) career paths with your instructor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
40) Met with my instructor outside of class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
41) Discussed ideas from your homework or classwork with your instructor outside of class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
42) Received prompt feedback (written or oral) from your instructor on your performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
43) Worked with your instructor on activities other than coursework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**This section of the survey will ask general questions about your math courses, college credits, advising information, and demographics.**

44) Select the steps you took to register for your first math class at this college: **(select all that apply)**

- Took an Accuplacer test to determine my first math course
- Spoke with a college advisor about my high school transcript
- Met with the math department head to determine in which math class to enroll
- Other (please provide an explanation in the answer box below)

\_\_\_\_\_

45) Do you feel you were accurately placed in your current math course? If no, please explain why not.

- Yes
- No, I was placed in a math class that was too easy: \_\_\_\_\_
- No, I was placed in a math class that was too hard: \_\_\_\_\_

46) Middle-skill jobs are Science, Technology, Engineering, and Math (STEM) related careers which require a certificate or Associate's degree and offer a starting salary comparable to positions obtained by those with a Bachelor's degree. Have you been made aware of the middle-skill job openings available to qualified candidates with a certificate or Associates degree in a STEM related field?

- Yes, I am aware of the STEM related opportunities.
- No, I am not aware.

47) Who gave you information about middle-skill jobs?

48) Are you currently working on obtaining a STEM related certificate or degree?

- Yes
- Haven't decided yet.
- No

49) Was the information that was provided to you about middle-skill jobs the reason you are earning a STEM related certificate or degree? Why or why not?

- Yes, and this is why: \_\_\_\_\_
- No, and this is why not: \_\_\_\_\_

50) In which month and year did you first enroll at this college? (Enter in this format: mm/yyyy) Month/Year

51) While you have been enrolled at this college, how many math classes have you taken?

52) Have you repeated any math courses so far?

- Yes
- No

53) How many college credit hours are you taking this semester?

54) If you are employed, how many hours do you work per week on average?

- I am currently not employed.
- 1-10 hours
- 11-20 hours
- 21-30 hours
- 31-40 hours
- More than 40 hours a week

55) Are you caring for any children or other family members?

- Yes
- No

56) Does your family rely on your income?

- Yes
- No

**Please share some information about you:**

57) What is your gender?

- Male
- Female
- Prefer not to answer

58) What is your age?

59) What is your racial/ethnic background? **(Select all that apply.)**

- White
- Black or African American
- American Indian or Alaska Native
- Hispanic/Latino
- Asian
- Native Hawaiian or Pacific Islander
- Prefer not to answer

60) Which statement best describes the highest level of education reached by your parents?

	Highest Level	
	Mother	Father
Did not attend high school	<input type="radio"/>	<input type="radio"/>
Attended but did not finish high school	<input type="radio"/>	<input type="radio"/>
Earned a GED	<input type="radio"/>	<input type="radio"/>
Completed high school	<input type="radio"/>	<input type="radio"/>
Completed some college	<input type="radio"/>	<input type="radio"/>
Earned an Associate's Degree	<input type="radio"/>	<input type="radio"/>
Earned a Bachelor's Degree	<input type="radio"/>	<input type="radio"/>
Earned a Graduate Degree	<input type="radio"/>	<input type="radio"/>
Don't know	<input type="radio"/>	<input type="radio"/>
Prefer not to answer	<input type="radio"/>	<input type="radio"/>

61) Thank you for your time! Your feedback is extremely valuable. As a thank you, if you would like to be entered into a raffle for a \$50 Amazon gift card, please select "Yes, I would like to enter the raffle!" and enter your email address. **The email addresses for this question will be removed from the data PRIOR to analysis.** Otherwise, select "No, I have completed the survey."

- Yes, I would like to enter the raffle! My email address is: \_\_\_\_\_
- No, I have completed the survey.

## Appendix B

### Mathematics Faculty Experience Survey

#### Welcome to the Mathematics Faculty Experience Survey!

Thank you for participating in this survey. Your honest feedback is important. The purpose of this survey is to gain a better understanding of the supportive behaviors important to the pedagogical practices of mathematics faculty.

Your participation in this research study is voluntary. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. However, your participation is much appreciated and very valuable.

The online survey will take approximately five minutes. Your responses are confidential and no identifying information such as your name, email address, or IP address will be collected. The survey poses minimal risk and poses no additional harm to participants than their routine daily activities.

All data is stored in a password protected electronic format. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The aggregate results of this study will be used for scholarly purposes only.

If you have any questions about the research study, please contact Rachel Santiago at (585) 292-2969. If you experience emotional or physical discomfort due to participation in this study, please contact the Health and Wellness Center at (585) 385-8280 for appropriate referrals.

The survey has been adapted from the College Experience Survey (Barnett, 2011). The Institutional Review Board (IRB) of St. John Fisher College has reviewed this project. For any concerns regarding confidentiality, please call Jill Rathbun 585-385-8012. She will direct your call to a member of the IRB at St. John Fisher College.

**By clicking I DO CONSENT, PROCEED TO SURVEY you are verifying that you have read the above and give consent to participate in the study. You also agree that you are participating voluntarily.**

- I DO CONSENT, PROCEED TO SURVEY
- I DO NOT CONSENT

Which of the following courses have you previously taught or are currently teaching?  
(Select all that apply.)

- MTH 096 (080)
- MTH 098
- MTH 104
- MAT 095
- MAT 097

**In the following section, a six-point scale is used from "Very Strongly Disagree" to "Very Strongly Agree."**



In my developmental math course(s)...

	Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree
1) I help my students to believe in themselves.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) I talk with my students about their personal goals for their education.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) I show genuine care for how my students are doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) I understand that my students come from different backgrounds.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) I am interested in what my students have to offer in class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) I encourage my students to openly share their views in my class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) I show that I believe in their ability to do the classwork.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) I know who my students are.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) I am willing to take as long as needed to help my students understand the class material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) I help my students feel like capable learners.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) I help my students feel like they bring valuable ideas to class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) I interact with my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) I am willing to give individual help when needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14) I show genuine care for whether my students are learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) I encourage students from diverse backgrounds to contribute to class discussion.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In my developmental math course(s),...

	Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree
16) I encourage my students to share life experiences when they relate to the class material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17) I encourage my students to express their honest opinions in class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18) I provide written feedback on the assignments and tests turned in to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19) I treat all of my students equally.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20) I make an effort to make my classes interesting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

With respect to my role at the college in general and specifically outside of the classroom,...

	Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree
21) I encourage students to become involved on campus.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22) I am easily accessible outside of class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23) I am easily accessible outside of my office.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24) I consider myself a mentor to at least one student.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**In the following section, a four-point scale is used from "Never" to "Always."**

In your experiences as a math instructor at this college, how often have you done each of the following:

	Never	Sometimes	Very often	Always
25) Used email to communicate with your students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26) Discussed grades or assignments with your students in office hours	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27) Talked about career plans with your students outside of class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28) Discussed ideas from any class material with your students outside of class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29) Given prompt feedback (written or oral) to students on their individual performances	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30) Worked with students on activities other than coursework outside of class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31) Talked about STEM related careers with your students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32) Maintained an open-door policy for former students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**This next section will ask various questions regarding your opinion on academic background, the time you have spent at the college, and demographics.**

33) How can the college respond to the diverse academic backgrounds of the students?

34) How many years have you taught at this college?

35) How many credit hours are you teaching this semester?

36) Are you currently teaching at any other colleges or have other teaching obligations?

Yes; I am teaching the following number of credit hours outside of this college:

\_\_\_\_\_

No, I am not.

37) What is your opinion of the mathematics placement process at this college?

**Please share some information about you:**

38) What is your gender?

- Male
- Female
- Prefer not to answer

39) What is your racial/ethnic background? (Select all that apply.)

- White
- Black or African American
- American Indian or Alaska Native
- Hispanic/Latino
- Asian
- Native Hawaiian or Pacific Islander
- Prefer not to answer

40) Thank you for your time! Your feedback is extremely valuable. As a thank you, if you would like to be entered in a raffle for a \$50 Amazon gift card, please select "Yes, I would like to enter the raffle!" and enter your email address. **The email addresses for this question will be removed from the data PRIOR to analysis.** Otherwise, select "No, I have completed the survey."

- Yes, I would like to enter the raffle! My email address is: \_\_\_\_\_
- No, I have completed the survey.

## Appendix C

### Permission for Adaptation of College Experience Survey

**Santiago, Rachel** <\_\_\_\_\_>  
To: \_\_\_\_\_

Sat, Aug 22, 2015 at 1:56 PM

Good afternoon,

I am writing to request permission to use the College Experience Survey to assess the impact of faculty validation on developmental mathematics students. This will be used for my doctoral dissertation at St John Fisher College in Rochester, NY. I will be conducting the study sometime in the early Spring of 2016. Any questions or concerns you may have, please feel free to email or call at \_\_\_\_\_. Thank you in advance for your consideration, and I hope you are having a wonderful summer!

Cheers,

Rachel Santiago

---

**Barnett, Elisabeth** <\_\_\_\_\_>  
To: "Santiago, Rachel" <\_\_\_\_\_>

Mon, Aug 24, 2015 at 5:05 PM

Hi Rachel--

You're welcome to use my survey. Just attribute it to me.

Good luck with your dissertation!

Elisabeth

[Quoted text hidden]

--

Elisabeth Barnett, Ph.D.  
Senior Research Associate  
Teachers College, Columbia University  
525 W. 120th Street, Box 110  
New York, NY 10027

## Appendix D

### Qualtrics Reminder Email

#### Reminder Email:

Good morning,

This email is to serve as a reminder to complete the survey. Your feedback is greatly appreciated! As a thank you, upon completion of the full survey, you have the opportunity to be entered into a raffle for a \$50 gift card! The winner will receive an email link to the gift card so as to maintain anonymity.

*<Take survey here>*

Thank you for your time and consideration!

Rachel Santiago  
Urban Community College Mathematics Instructor

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Doctoral Candidate in the Executive Leadership Program  
Ralph C. Wilson, Jr. School of Education  
St. John Fisher College

*The Institutional Review Board (IRB) of St. John Fisher College has reviewed this project. For any concerns regarding confidentiality, please call Jill Rathbun \_\_\_\_\_ . She will direct your call to a member of the IRB at St. John Fisher College.*

## Appendix E

### Qualtrics Thank You Email

Thank you for your participation in the survey! As a reminder, your responses will be completely confidential and will be stored in a secure file that is password protected. Your responses will remain anonymous. Results will be presented as summaries and individual responses will not be identified.

Sincerely,

Rachel Santiago  
Urban Community College Mathematics Instructor

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\_\_\_\_\_  
\_\_\_\_\_  
Doctoral Candidate in the Executive Leadership Program  
Ralph C. Wilson, Jr. School of Education  
St. John Fisher College

*The Institutional Review Board (IRB) of St. John Fisher College has reviewed this project. For any concerns regarding confidentiality, please call Jill Rathbun \_\_\_\_\_ . She will direct your call to a member of the IRB at St. John Fisher College.*



## Appendix F

### Math Faculty Survey Announcement

Dear Colleague,

This email is an invitation to participate in a survey I am conducting as a part of my dissertation research toward earning my doctorate. The purpose of this study is to examine the existence and importance of supportive faculty behaviors in the area of developmental math as reported by community college math faculty and students. The study will help to inform educators on classroom pedagogy as well as help identify what students experience and need for a successful college experience.

The survey itself should take about five minutes or less to complete. **A separate email with the survey link will be sent out on mm/dd.** In addition, there will be an opportunity to enter your name into a raffle for a \$50 gift certificate!

Thank you for your time and consideration!

Rachel Santiago  
Urban Community College Mathematics Instructor

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Doctoral Candidate in the Executive Leadership Program  
Ralph C. Wilson, Jr. School of Education  
St. John Fisher College

## Appendix G

### Survey Items Related to the Four Subconstructs

<b>Students Feeling Known and Valued</b>
I feel accepted as a person by my instructor.
My instructor understands that students come from different backgrounds.
My instructor is interested in what I have to offer in class.
I am encouraged by my instructor to openly share my questions and answers in class.
My instructor shows that (s)he believes in my ability to do classwork.
My instructor knows who I am.
My instructor is willing to take as long as needed to help me understand the class material.
I feel accepted as a capable student by my instructor.
My instructor makes me feel as though I bring valuable ideas to class.
It seems like my instructor really cares about whether I am learning.
I can generally express my honest opinions in my class.
I feel as though I am treated equally to other students.
My instructor generally remembers my name.

<b>Caring Instruction</b>
---------------------------

My instructor seems to genuinely care how I am doing.
---

I interact with my instructor outside of class.
---

My instructor is willing to give me individual help when needed.
--

My instructor provides lots of written feedback on the assignments or tests I turn in.
--

I feel like my personal and family history is valued in class.
--

My instructor makes an effort to make the class interesting.
--

My instructor encourages me and my classmates to become involved on campus.
---

<b>Appreciation for Diversity</b>
-----------------------------------

People from diverse backgrounds are encouraged to contribute to the class discussion.
---

I am encouraged to share life experiences when they relate to the class material.
---

Women and men are equally encouraged to contribute to class discussion.
---

<b>Mentoring</b>
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My instructor helps me to believe in myself.
--

My instructor has talked with me about my personal goals at this college.
---

I've had one or more instructors at this college whom I thought of as a mentor.
---

## Appendix H

### Survey Items Related to Student Outcomes

<b>Sense of Belonging</b>
I see myself as part of the campus community.
I feel a sense of belonging to the campus community.

<b>Competence</b>
Even if the work in my class is hard, I can learn it.
If I have enough time, I can do a good job on all of my coursework.
I'm certain I can do almost all the work in college if I don't give up.
I'm certain I can master the skills taught at this college.
I can do even the hardest coursework if I try.

<b>Persistence</b>
I am planning on returning to this college for the Fall 2016 semester.
I expect to complete a degree or certificate at this college.