ABSTRACT

STANSBURY, CALVIN EARL. The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study (Under the direction of Dr. James E. Bartlett, II).

The majority of students enroll in community college with the intention of earning a college certificate, diploma, or degree that will offer them access to better employment opportunities that pay a higher living wage. However, the number of college students who place into developmental mathematics far exceeds the number of students in other areas of developmental education and creates a major barrier that prevents many students from earning their college credential. *The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College* is an in-depth case study that investigates the pedagogical and instructional practices of developmental mathematics instructors who possess either a mathematics (education) and/or mathematics (non-education) credential and its impact on overall student success in developmental mathematics.

This research study utilized a qualitative case study methodology to address dismal student success rates through the lens of the developmental mathematics instructor. Seven individual developmental mathematics instructors and a focus group consisting of five developmental mathematics instructors participated in the research study which allowed for the findings presented herein. Open-ended interviews, focus interviews, and document reviews were used as the basis of the triangulation process which yielded the overall findings from the qualitative research (Yin, 2014) to arrive at the responses to the research questions, along with emergent themes that were used to arrive at a model of success in developmental mathematics. Four overarching themes emerged from the findings that support the success of
students in developmental mathematics and the resulting themes were coalesced into a model that supports student success in mathematics.
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The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study

by
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A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Doctor of Education

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DEDICATION

This dissertation is dedicated to my parents, Eula Stansbury (August 5, 1936 – November 11, 2009), Edward Sykes (February 2, 1915 – December 27, 1991), my brother, Lynn Lee Stansbury (September 19, 1954 – May 11, 2007), and my sister, Alice Mae Stansbury (December 1, 1956 – May 28, 2010). The spirit, inspiration, and love of each of you have empowered me to traverse this educational path to its summit.

Mom and Dad, neither of you received any formal education; therefore, this degree is dedicated to you and bears your name. Thank you for sharing and imparting unto me the importance of education. May I continue to make you proud and live up to the legacy that you left behind. Until we meet again beyond the clouds. I love you both beyond words!
BIOGRAPHY

Calvin Earl Stansbury is a native of Roanoke Rapids, North Carolina and is the youngest of seven children. After graduating from Northwest Halifax High School in June 1988, he matriculated at Elizabeth City State University in Elizabeth City, North Carolina and graduated in May 1992 with a Bachelor of Science degree in Mathematics. After working several years in the community college and in the public school system, he matriculated at Virginia State University in Petersburg, Virginia and graduated with a Master of Science degree in Mathematics in May 1997. Upon graduating from Virginia State University, he worked in the Virginia Community College System and the Department of Correctional Education as a math instructor and as an adult basic education instructor, respectively.

After relocating to North Carolina in 2008, he began teaching mathematics at Halifax Community College (HCC), Weldon, North Carolina where he taught both developmental mathematics and transfer mathematics courses. In 2011, he accepted the role of Division Chair of the School of Arts and Sciences which was later changed to the School of College Transfer, Business, and Education and remained at HCC until 2017. In July 2017, he accepted an administrative position as the Associate Dean of Sciences, Technology, Engineering, and Mathematics (STEM) at Prince George’s Community College in Largo, Maryland. He currently resides in Annapolis, Maryland.
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CHAPTER ONE: INTRODUCTION

Community colleges provide a gateway to the workforce by the credentials that it offers to its students. Research indicates that the majority of students enroll in community college with the intention and aspiration of earning a college certificate, diploma, or degree that will offer them access to better employment opportunities that pay a higher living wage (Bye, Pushkar, & Conway, 2007; Compton, Cox, & Laanan, 2006; Francois, 2014; Ross-Gordon, 2003). Yet, underprepared students, as indicated by their enrollment in developmental education, are less likely to succeed and earn a college credential that leads to better, higher paying jobs (Achieving the Dream, 2009; American Association of Community Colleges [AACC], 2012). Numerous studies articulate the extensive use of developmental education services at postsecondary institutions. Findings from the U.S. Government Accountability Office indicate that nearly 42% of new community college students are not prepared for college-level work and are enrolled in at least one developmental education course (U.S. Government Accountability Office [U.S. GAO], 2013). According to a research finding from Bailey and Cho (2010), approximately 60% of incoming college students place into at least one developmental course. Another research report by Phelps and Evans (2006) reveals that approximately half of the students who enter community colleges are in need of and are enrolled in at least one developmental course, and the course that is needed is usually developmental mathematics. While developmental courses are serving an important purpose, many community colleges struggle to reduce the need for these courses.

There are approximately 1,200 community colleges in the United States that provide open-door admission to nearly 8 million students (Cohen & Brawer, 2008; AACC, 2015). Of the millions of students who are enrolled in community colleges, many are required to enroll
in developmental education courses as a result of placement tests in reading, writing, and mathematics (Bailey & Cho, 2010; U.S. GAO, 2013). Developmental education, sometimes referred to as remedial coursework, is defined as coursework at a community college or university that is below “college-level” work, and the students who test into these classes are determined to be underprepared for certain collegiate work (Achieving the Dream, 2009; Dotzler, 2003; Parmer & Cutler, 2007; Stigler, Givvin & Thompson, 2009). According to Parmer and Cutler (2007), underprepared college students quickly confront an educational divide that shifts their educational goals farther from attainment, consequently, fewer students earn a college credential. According to the Commission on the Future of Higher Education report, many high school graduates who matriculate at a postsecondary institution waste time and money remediating English and math skills that they should have acquired in high school (U. S. Department of Education [U.S. DE], 2006).

In a comparative perspective, the number of community college students who place into developmental mathematics far exceeds the number of students in other areas of developmental education, including developmental English which encompasses both reading and writing courses (Bellafante, 2014; Howard & Whitaker, 2011; National Center for Education Statistics [NCES], 2013; Shore & Shore, 2003; Sparks & Malkus, 2013; U.S. GAO, 2013). In a more recent study, according to King, McIntosh, and Bell-Ellwanger (2017), 59% of beginning postsecondary students placed into developmental mathematics as compared to 33% of their counterparts in English-related developmental courses. Research by Bonham and Boylan (2011) further supports the finding that developmental mathematics serves as a gatekeeper course that precludes many students from enrolling in a required curriculum mathematics course, thereby, preventing students from completing their
credential or diploma requirements. Students fail to enroll in curriculum-level mathematics courses for a myriad of reasons related to developmental mathematics, including high rates of failure and non-completion, absence of content relevance, minimal support from colleges, faculty who lack interest in teaching developmental mathematics, and faculty who fail to understand the plight of the developmental mathematics student (Sierpinska, Bobos, & Knipping, 2008). As a result, the number of community college students who successfully complete developmental mathematics is significantly lower than other areas in developmental education (NCES, 2013).

The goal of credential attainment by community college students at the nation’s 1,200 community colleges serves as a major tenet among educational entities (AACC, 2012; Price & Roberts, 2008), as shown by initiatives that support attaining stackable credentials and graduating. For many years, the United States produced more college educated individuals than any other nation on the globe; however, the trend has reversed and other countries have taken the lead in producing college graduates (U.S. DE, 2006). According to the American Association of Community Colleges (2012), America’s college graduation rates, once the highest among developed nations, have fallen behind in comparison to Russia, South Korea, Japan, and Canada.

Low graduation rates have far reaching consequences. According to the American Association of Community Colleges (2012), a vibrant economy and a formidable democracy are contingent upon the perpetual development of an educated citizenry. In 2009, President Barack Obama laid out the components of the 21st-Century Commission on the Future of Community Colleges in his Joint Session of Congress. He remarked on the importance of every American working to support and reenergize the economy by earning a college
credential to compete in a global economy and to help America become the highest producer of college graduates in the world (AACC, n.d.). Several community college organizations, including the American Association of Community Colleges (AACC), the Association of Community College Trustees (ACCT), the National Institute for Staff and Organizational Development (NISOD), the League for Innovation in the Community College, Phi Theta Kappa (PTK), and the Center for Community College Student Engagement (CCCSE), joined their efforts in support of President Obama’s directive to increase college graduation rates by jointly signing a commitment to boost student completion by 50% (AACC, 2015a).

By 2018, nearly two-thirds of American jobs will require a college certificate, diploma, or degree (AACC, 2012; Carnevale, Smith, & Stohl, 2010). The goal of the completion initiative is to increase the number of college graduates who earn a certificate, diploma, or degree by 50% by 2020, in order to assume 21st century job roles that support the U.S. economy and reduce educational disparities. This initiative is an important mission of the 21st century community college because students must be prepared for 21st century jobs that both sustain and grow the U.S. economy.

By 2020, the 21st-Century Commission on the Future of Community Colleges intends to also curtail the number of underprepared students who enroll in college by 50% and increase the number of students who complete developmental education courses. According to the American Association of Community Colleges (2012), less than 46% of community college students complete a postsecondary credential, transfer to another institution, or are continuously enrolled after six years. Some postsecondary students never complete their degree at all, at least in part because most colleges and universities do not accept
responsibility for making sure that those they admit ultimately succeed (USDE, 2006). This lack of responsibility takes a tremendous toll on developmental educations courses.

The literature also reveals that approximately 42-60% of students place into developmental education (Bailey & Cho, 2010; Phelps & Evans, 2006; U.S. GAO, 2013) and that more incoming students place into developmental mathematics than other developmental courses (NCES, 2013; Phelps & Evans, 2006). Several studies (Bellafante, 2014; Howard & Whitaker, 2011; Phelps & Evans, 2006; Shore & Shore, 2003) corroborate the findings by the National Center for Education Statistics that indicates that approximately 60-75% of new community college students require developmental mathematics. The intention of developmental education is to provide underprepared students the opportunity to enhance their academic skills in order to be successful in college-level work (Bailey, Jeong, & Cho, 2008) and eventually graduate. However, developmental education students graduate at a significantly lower percentage than non-development students (Achieving the Dream, 2009). These students’ attainment of a college credential is compromised by barriers that developmental education courses often create for the students that they are designed to help. The findings of Bailey and Cho (2010) support the claim made by Achieving the Dream that indicates that less than 25% of students enrolled in developmental education courses complete their college credential within eight years, as opposed to their non-development education peers who complete their college credential at a rate of nearly 40%. According to the Community College Research Center (CCRC, 2008), only 30-40% of students who enroll in sequential developmental courses complete the developmental course sequence because many of the developmental students withdraw from the sequence before they complete the first developmental course in the sequence. The findings from Bailey and Cho (2010)
revealed a decline in the percentage of developmental education students who graduate in comparison to the Community College Research Center in 2008. The decline seemed to indicate that although developmental education has experienced reformation initiatives, more work on student success and completion in developmental education need to be assessed and addressed.

Developmental education classes are generally comprised of courses in reading, writing, and mathematics with multiple-sequence courses that must be successfully mastered prior to entry into college-level curriculum courses. The attainment of a college credential is compromised by barriers that developmental education often creates for the students that it is designed to help. Developmental mathematics can present a greater obstacle for developmental students because while developmental English may have as few as two levels, developmental mathematics may contain up to five levels or tiers (Boylan, 2011). Once enrolled in developmental mathematics, the time required to transition through the developmental mathematics sequences present yet another barrier. U.S. Secretary of Education Margaret Spelling’s Commission on the Future of Higher Education Report spotlighted the need to “reduce time to completion” in developmental education (USDE, 2006).

By 2018, the U.S. economy will produce millions of jobs that require a credential beyond a high school diploma (Carnevale, Smith, & Stohl, 2010). These jobs will often require specialized math skills. Therefore, as a result, student success and completion rates in developmental mathematics must continue to be a national educational agenda item (Bonham & Boylan, 2011; Cafarella, 2016; Zientek, Ozel, Fong, & Griffin, 2013) that will
invite reformation initiatives to mitigate the challenges that plague developmental
mathematics students nationwide.

The remainder of chapter one will include the statement of the problem, the purpose
statement, the theoretical framework, the conceptual framework, research questions, the
significance of the study, limitations, delimitations, definition of terms, and the chapter one
summary.

**Statement of the Problem**

Employees with a high school diploma or less are often limited to jobs that pay less
than a living wage. Perpetual changes and advances in technology are resulting in more 21st
century jobs that require the minimum of a college certificate, diploma, or degree.
According to Carnevale, Smith, and Strohl (2010), by 2020 the U.S. economy will produce
millions of jobs that will require a credential that exceeds a high school diploma.

Community colleges are the primary institutions that afford many students the
opportunity to complete their postsecondary education and earn a college credential (Cohen
& Brawer, 2008; Price & Roberts, 2008). However, community colleges are enrolling an
increasing number of underprepared students, particularly mathematics (Achieving the
According to Cafarella (2016), developmental mathematics has been “on the postsecondary
educational radar” for many years. Each year, many students are unsuccessful in
developmental mathematics in the nation’s 1,200 community colleges. Failing
developmental mathematics creates an insurmountable roadblock for millions of community
college students. As a consequence, students who are unsuccessful in a developmental
mathematics course inevitably fail to enroll in a curriculum-level mathematics course

required to complete their college credential. Failure to earn a college credential results in students being inadequately prepared to join the 21st workforce, nationally and internationally.

Research by Bonham and Boylan (2011) corroborates the finding that developmental mathematics essentially prevents many college students from attaining their educational credential. Students who abandon their goal of earning a college credential often find that living wage jobs are out of reach. According to Parmer and Cutler (2007), underprepared college students quickly confront an educational barrier that expands the gulf between enrolling in college and actually earning a college credential.

In the developmental mathematics classroom, numerous factors are tied to student success. This research study utilizes a qualitative case study research design to investigate the role of faculty credentials on student success in developmental mathematics at a community college. Understanding the role of faculty credentials on student success in developmental mathematics will spotlight the challenges confronted by millions of students who are trying to advance through their developmental mathematics sequence, enroll in the required curriculum level mathematics for the respective degree or diploma program, earn a college credential, and subsequently enter the workforce. Developmental mathematics serves as a gatekeeper course for many community college students. If this problem is not solved, then millions of students will stall in developmental mathematics without earning a college credential that will equip them for many 21st century jobs.

**Purpose Statement**

The purpose of this qualitative case study is to determine how the academic credentials of a developmental mathematics instructor influences student success in
developmental mathematics at community colleges. There are numerous environmental factors that are at play in the developmental mathematics classroom. As an environment, the developmental mathematics classroom is shaped by the beliefs, the attitudes, and the experiences of both students and faculty; however, this research study will focus on how the academic credential of the developmental mathematics instructor impacts success by investigating instructional strategies, beliefs about developmental mathematics and developmental education students, and educational ideology.

The research design will use case study methodology to assess student success in developmental mathematics as an output of the function of the classroom experience based on the academic credentials of the developmental mathematics instructor. Several factors that impact the developmental mathematics classroom will be investigated including faculty credentials, pedagogy, teaching experience, faculty attitudes, and beliefs about developmental mathematics and developmental mathematics students. Furthermore, this study will investigate the overall mastery or non-mastery in developmental mathematics, persistence, engagement, and the instructional strategies utilized by developmental mathematics instructors who possess a credential in mathematics education as compared to developmental mathematics instructors who possess a credential in pure mathematics with no coursework in education.

**Theoretical Framework**

According to Merriam (1988), substantive theory is tied closely to real-life situations that occur in specific situations. The Theory of Involvement (TI) is a type of substantive theory on the basis of its application to educational settings. Determining how the academic credentials of a developmental mathematics instructor influence student success in
developmental mathematics courses at a community college will be viewed from the theoretical framework of the theory of involvement as developed by Alexander Astin in 1984.

The input-environment-output (I-E-O) model is a derivative of the theory of involvement. The input-environment-output model references inputs as particular attributes that students bring to a learning environment including students’ demographics, background, and past experiences. However, according to Thurmond and Popkess-Vawter (2003), inputs can also be such constructs as “antecedent conditions” used in research that influence both the environment and output. In this research design, the academic credentials of developmental mathematics instructors will be evaluated as inputs in the developmental mathematics classroom and on the overall success of students in developmental mathematics.

The second prong of the I-E-O model is the environment. According to Astin (1993), environment refers to the experiences of a student during an education program. Thurmond and Popkess-Vawter (2003) indicate that the environment is a multi-faceted construct that may involve curriculum, teaching style, and instructor that may impact the outcomes in the model. This research will investigate the environment of the developmental mathematics classroom on the basis of the environmental constructs orchestrated by the developmental mathematics instructor to include pedagogy (instructional strategies) and classroom climate. The classroom climate incorporates factors that impact student learning, including instructional strategies and whether the classroom is nurturing, inviting and engaging, or stressful and threatening.

According to the input-environment-output (I-E-O) model, outputs are outcomes that result from the impact of both the input and the environment. Astin (1993) indicates that
outputs are the esteemed outcomes. The desired outputs from this research is to assess the impact of faculty credentials on the developmental mathematics classroom, including students’ mastery or non-mastery, persistence, and engagement in developmental mathematics.

The theory of involvement posits that for learning and growth to occur, students must be actively involved in the learning environment. The mathematics classroom can be an intimidating place for many students; therefore, getting students actively involved in the classroom can be a huge undertaking for the developmental math instructor. Milem and Berger (1997) explained in their research that involvement is a crucial component as it relates to student persistence. Without persistence, it is impossible for students to earn their college credential. In the developmental mathematics classroom, students must be involved in the learning process to realize the relationship between student persistence and student success. Students must understand that student persistence is a prerequisite for student success in developmental mathematics. The theory also states that student learning is proportional to both the quality and quantity of their involvement in the environment.

This research study uses the faculty credentials of the developmental mathematics instructor as the input variable. The developmental mathematics classroom is greatly impacted by the credential of the faculty members, including mathematics (education) and mathematics (non-education). Their credentials determine the instructional strategies that are incorporated into the developmental mathematics classroom, as well as instructors’ beliefs and attitudes toward developmental mathematics and developmental mathematics students. The success outcome of the study will consist of mastery or non-mastery of the developmental mathematics content, student persistence, and engagement.
Astin also created five basic assumptions about involvement that can be correlated to the study proposal regarding student success. Although the theory involves co-curricular student involvement, this research can be used to frame the research project to show how a faculty credential differentiation can be used to explain the differences in students’ experiences within a developmental mathematics classroom (environment). Based on the pedagogical training of the developmental mathematics instructor, he or she may be able to positively impact student success outcomes in developmental mathematics courses, in part, due to a credential in education that supports teaching and learning.

Conceptual Framework

This research design will utilize Alexander Astin's (1993) Input-Environment-Output (I-E-O) model to frame the impact of faculty credentials on the developmental mathematics classroom in shaping the success of developmental mathematics students in a community college. The faculty credential designates the input of the model, the developmental mathematics classroom represents the model’s environment, and the mastery or non-mastery of developmental mathematics, persistence, and engagement constitute outputs of the model. The conceptual model of the research design is pictured in Figure 1. The three rectangles represent the components of the I-E-O model and have been renamed to reflect the components of the study: faculty credentials, the developmental mathematics classroom, and student success.
Figure 1. Conceptual Framework


**Research Questions**

This research study examines the following questions related to the academic credentials of developmental mathematics faculty and the success of students in developmental mathematics at a community college.

**RQ1:** What are the pedagogical practices of developmental mathematics instructors who have either a mathematics education or mathematics (non-education) degree?

**RQ2:** How are the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree similar to developmental mathematics instructors who earned a mathematics (non-education) degree?
RQ3: How are pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree different than those utilized by developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ4: How do the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who report high student pass rates differ from developmental mathematics instructors who do not have high pass rates?

**Significance of Study**

This research study is significant for a number of reasons. Student success rates in developmental mathematics are a focal point on the national educational agenda (Bonham & Boylan, 2011; Zientek, Ozel, Fong, & Griffin, 2013). Sustaining and growing an economy that prepares students for 21st century national and international jobs is one of the major tenets of the 21st century community college (AACC, 2012). Community colleges have an open-door policy and many underprepared students enter the doors of their local community colleges with the hopes of earning a certificate, diploma, or degree that will afford them access to the workforce that allows them greater earning potential based on their attainment of a college credential. However, due to the unpreparedness of many students who enter the community college doors, more than 50% of those students place into developmental education. Underprepared students quickly confront an educational divide that shifts their educational goals farther from attainment, consequently leading to fewer students earning a college credential.

The nation is facing a crisis in community colleges as more students are attending community college and placing into developmental mathematics (Adelman, 1985; Bailey et
al., 2005). According to the National Center for Education Statistics, the number of community college students who place into developmental mathematics far exceeds the number in other areas of developmental education (Sparks & Malkus, 2013). Research by Bonham and Boylan (2011) supports the finding that developmental mathematics serves as a gatekeeper course that precludes many students from enrolling in the required curriculum mathematics course, thereby, preventing them from attaining their “educational credential.” Students who do not earn their college credential find themselves disqualified for many living wage jobs in the 21st century job market.

This researcher posits that continuous research must be done to mitigate the challenges faced by the millions of developmental mathematics students enrolled in the nearly 1,200 community colleges across the United States. These challenges must be addressed to ensure that these students will earn a college credential in order to qualify and compete for 21st century jobs. This study is significant at both the micro and macro levels of institutions and research. At the micro level, the findings from this study will provide the leadership and faculty at community colleges with outcomes that support or dispute the methodology used to assign instructors to developmental mathematics courses. At the macro level, the findings from this research will be used to add to the existing body of literature on the classroom practices that support efforts to ensure that developmental mathematics students are successful in their pursuits to earn their college credential.

Propositions

Quantitative research implies the absence of researcher assumptions and biases. However, according to Merriam (1988), in a case study research design, the researcher is the primary instrument for collecting and analyzing the research findings. Due to the humanity
of the researcher, errors occur and prejudices impact the overall research findings. Yin (2014) posits that theoretical propositions ultimately impact research questions, the literature review, and the formulations of new propositions. On the basis of the researcher’s experience with developmental education, developmental mathematics students, and pedagogy, the researcher expresses his inclination that developmental mathematics instructors who possess a mathematics degree in education are better suited to teach developmental mathematics students. Additionally, on the basis of their volunteer participation in the research study, it will be assumed that participants who are interviewed face-to-face or participate in the focus group interview will respond to questions openly and honestly.

**Limitations**

The study is limited by the following:

1. Availability of developmental mathematics faculty during the fall of 2017.
2. Number of volunteers for developmental mathematics focus group session.
4. Subjectivity of participant responses and beliefs.
5. Subjectivity of researcher interpretation.
6. Time constraint and costs.
7. Diverse educational and teaching experiences of participants.
8. Case study not generalizable to all developmental mathematics faculty.
9. Self-reporting of instructors who have high versus low student pass rates.

**Delimitations**

The study will be delimited by the following:
1. The study will be conducted during the fall of 2017.

2. Seven developmental mathematics instructors will be interviewed face-to-face.

3. Only developmental mathematics instructors will be included in the study.

4. Research participants will be current employees in the North Carolina community college system

5. Research participants will possess either a mathematics (education) or mathematics (non-education) credential.

**Definition of Terms**

The following are a list of terms and their operational definitions in accordance with the purposes of this research study.

*College ready.* For the purpose of this study, college ready is indicative of an individual who has earned a high school diploma or high school equivalency and has the English and mathematics knowledge and skills necessary to qualify and succeed in entry-level, credit-bearing college courses without the need for developmental coursework (Conley, 2008).

*Community college.* An educational institution that is regionally accredited to award an associate’s degree (Cohen & Brawer, 2008).

*Developmental education.* Developmental coursework is defined as coursework at a community college or university that is below “college-level” work (Parmer & Cutler, 2007, p. 37; CCRC, 2008). Students must meet specific testing requirements in accordance with the college’s placement process in order to enroll in college-level courses.

*Developmental mathematics.* Developmental mathematics are skills that include coursework that begins with basic arithmetic, pre-algebra, elementary algebra and
intermediate algebra that must be taken before college-level mathematics (Stigler, Givvin, & Thompson, 2009).

*Educational credential.* For the purpose of this study, an educational credential is an undergraduate or graduate degree that has been earned from an accredited institution that equips a faculty member to teach and facilitate instructional activities in a specific discipline (Goldhaber & Brewer, 1996).

*North Carolina Diagnostic Assessment and Placement (NC DAP).* In 2013, to align with the developmental mathematics redesign initiative, the North Carolina Community College System adopted the NC DAP test to place incoming community college students into either developmental or curriculum college courses. The NC DAP placement ranges from 1 thru 10. Students who earn less than 7 are required to be placed into the corresponding Developmental Math (DMA) course that aligns with the corresponding placement test.

*Student Success.* For the purpose of this study, student success will be identified by the mastery or non-mastery of the developmental mathematics content, persistence, an improved sense of self-efficacy and self-regulation, and less mathematics anxiety.

*Transfer Courses.* According to the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC, 2006), associate degree courses that transfer to a baccalaureate degree must be taught by a faculty member who holds a doctorate or master’s degree in the teaching discipline or a master’s degree with a minimum of 18 graduate hours in the teaching discipline. For faculty teaching associate degree courses that do not transfer to a bachelor’s degree, a bachelor’s degree or associate’s in the teaching discipline is all that is required (Southern Association of Colleges and Schools Commission on Colleges, 2006).
Underprepared students. This research study defines underprepared student as students who score below college requirements to enroll into college-level courses in mathematics (Deil-Amen, 2011).

Summary

Developmental education has been referred to as the place where college dreams go to die because of the dire success rates of students who place into and complete developmental education courses at community colleges (Bailey & Cho, 2010). Statistics reveal that less than 25% of students who enroll in developmental education courses at the community college actually complete their degree within eight years of initial enrollment. According to Bailey and Cho (2010), developmental education is classified as one of the most challenging and important concerns on the community college agenda.

Developmental mathematics, a subset of developmental education, poses even more of a challenge than developmental reading and writing. The literature (Shore & Shore, 2003; Howard & Whitaker, 2011; Bellafante, 2014) supports the claim made by the National Center for Education Statistics indicating that approximately 60-75% of new community college students require developmental mathematics. Developmental mathematics serves as a gatekeeper course that precludes many students from enrolling in the required curriculum mathematics course, which consequently keeps students from earning their college credential (Bonham & Boylan, 2011).

The majority of jobs in the 21st century economy entail non-repetitive tasks, pay a living wage, and require a postsecondary credential (certificate, diploma, or associate degree). Community colleges enroll nearly 8 million students and award over a million degrees and certificates annually (AACC, 2014; AACC, 2015); therefore, the community
college plays a major role in helping to achieve the educational goal of President Barack Obama’s administration. The Obama administration’s goal of increasing the number of community college graduates by 5 million by 2020 will certainly not be without its challenges until reforms are made that mitigate the challenges associated with developmental education, including adequate placement testing, defining “college-ready”, and shortening developmental education sequences.

In the wake of research that has been done to explain causal relationships in developmental mathematics, student success in developmental mathematics continues to be an overarching concern on the community college success agenda. Research has been done on the impact of faculty characteristics, including age, gender, educational preparation, teaching experiences and employment status (part-time or full-time) (Penny & White, Jr., 1998). Additional research is needed to add to the body of knowledge on the impact of the academic credentials of developmental mathematics instructors on student success in developmental mathematics courses at a community college. Therefore, this research investigates the impact that the credentials of developmental mathematics faculty have on students who are trying to advance to the required curriculum level mathematics, earn their college credential, and enter the workforce with a job that pays a living wage.
CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this qualitative case study is to explore how the academic credentials of a developmental mathematics instructor inherently impacts the success of developmental mathematics students at a community college. The developmental mathematics classroom is shaped by the instructor’s knowledge of teaching and learning, attitude, beliefs, and experiences. Overall success of developmental mathematics students is determined by a combination of variables, including mastery of developmental mathematics content, improved self-efficacy, self-regulation, persistence, and the minimization of mathematics anxiety. Each of these variables can be positively or negatively influenced by the classroom instructor. This case study’s research will focus on the success of developmental mathematics students as defined as content mastery, persistence, and engagement.

This case study sought to answer the following questions related to the academic credentials of developmental mathematics faculty and the success of students in developmental mathematics at a community college.

RQ1: What are the pedagogical practices of developmental mathematics instructors who have either a mathematics education or mathematics (non-education) degree?

RQ2: How are the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree similar to developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ3: How are pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree
different than those utilized by developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ4: How do the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who report high student pass rates differ from developmental mathematics instructors who do not have high pass rates?

Understanding the impact that the faculty credentials of a developmental mathematics instructor have on the overall success of the developmental mathematics students can improve the hiring practices at community college colleges to ensure that the best-suited and most qualified developmental educators are hired to teach and facilitate developmental mathematics classrooms. With the best-suited developmental mathematics instructors in developmental mathematics classrooms, the lives and outcomes for millions of developmental mathematics students can be positively impacted to ensure that students master developmental mathematics content, enroll and complete their curriculum-level mathematics course, and subsequently graduate with a college credential.

The United States is home to approximately 1,200 community colleges that provide open-door admission to nearly 8 million students (AACC, 2015; Cohen & Brawer, 2008). Of the millions of students who are enrolled in community colleges, many students are required to enroll in developmental education courses as a result of placement tests in reading, writing, and mathematics.

Developmental education is defined as coursework at a community college or university that is below college-level work, and it is this population of students who are underprepared for collegiate work (Parmer & Cutler, 2007; Stigler, Givvin & Thompson, 2009; Achieving the Dream, 2009). Of the underprepared students who enter the community
college, many face an educational divide between their ability and the expectations of college that challenges their goal of attaining their college credential (Parmer & Cutler, 2007). Of the overall population of students who place into developmental education, the number of college students who place into developmental mathematics far exceeds the number of students in other areas of developmental education (Bellafante, 2014; Howard & Whitaker, 2011; NCES, 2013; Shore & Shore, 2003; Sparks & Malkus, 2013). Research by Bonham and Boylan (2011) confirmed the finding that developmental mathematics serves as a gatekeeper course that precludes many students from enrolling in the required curriculum mathematics course, thereby preventing students from attaining their “educational credential.”

In an effort to understand the problem through a different lens, this literature review will investigate student success in developmental mathematics at the community college level by delving into the following topics: the community college, the history of developmental education, developmental mathematics in North Carolina, community college faculty, community college credentialing, preparing postsecondary developmental mathematics instructors, the impact of faculty characteristics on student success, the developmental mathematics classroom, andragogy, mathematics anxiety, and barriers to student success in developmental mathematics.

The Community College

A community college is an educational institution that is regionally accredited to award an associate’s degree (Cohen & Brawer, 2008). Historically, the term “junior college” was given to two-year institutions that were supported largely by churches and private
organizations, whereas the term “community college” was used when referencing a two-year institution that received their primary funding from public funds (Cohen & Brawer, 2007). After the 1970s, the phrase community college was used to reference either regardless of the source of the institution’s finances.

According to Cohen & Brawer (2008), community colleges in America began in the early twentieth century. Joliet Junior College, founded in 1901 in Joliet, Illinois, is recognized as the first community college in the United States (AACC, 2013). Historically, the community college was established to meet the needs of the citizens within its geographical service area, including access to job training and transfer education (Cohen & Brawer, 2008; Townsend, 2001). According to Townsend (2001), when public junior colleges were initially created, their mission was transfer education. After the formation of the first community college, these institutions sought to offer job-training opportunities to alleviate unemployment issues and to equip workers with the skills to work in the growing industrial era (Cohen & Brawer, 2008).

Post World War II economic initiatives helped to reconfigure community colleges as a provider of diverse and relevant higher education options for its citizens. The Truman Commission is responsible for the suggestion that created the current network of public community colleges that were purposed to serve local needs (AACC, 2013). Today, nearly half of undergraduate students attend community colleges (AACC, 2013). According to Cohen and Brawer (2003), the community college has assumed additional goals as part of its mission to also include student services, career counseling, transfer opportunities, developmental education, and community education. Even though the 21st century community college has assumed additional services as part of its mission over its history, job
training and workforce development continue to be central to its overall mission (AACC, 2012). Many people believe that the community college has too many missions and that trying to achieve all the missions thwarts the change initiatives that community colleges seek to accomplish. As a result, community colleges are fashioned primarily as educational institutions that assist students in their quest to earn a college credential (Cohen & Brawer, 2008; Price & Roberts, 2008) because most 21st century jobs require a college certificate or degree (AACC, 2012).

Although technological advances and globalization can and often do negatively impact employment opportunities in America and abroad, they also create a need for a highly skilled workforce. Therefore, even though many community colleges may not be able to readily create programs that meet the need of high-demand areas of technology due to economic constraints, they must be willing to provide their students with access to technological and globalization experiences that ensure that they possess the skills that enable them to compete nationally and globally (Romano & Dellow, 2009).

The majority of jobs in the 21st century economy entail non-repetitive tasks, pay a living wage, and require a postsecondary credential, such as a certificate, diploma, or associate’s degree. By 2020, nearly two-thirds of the jobs in the U.S. economy will require a credential that exceeds a high school diploma (AACC, 2012; Carnevale, Smith, & Strohl, 2010). However, many of the 21st century jobs are out of reach for many who cannot complete their college credential as a result of the hurdles presented by developmental mathematics. Therefore, in order to mitigate the challenge of developmental mathematics, interventions must be instituted to assist community college students to enroll, persist, and be
successful in developmental mathematics to ensure that they graduate and earn a college credential that will qualify them for jobs in the 21st century workforce.

**History of Developmental Education**

During the inception period of postsecondary institutions, few aspired to earn a college credential because jobs during the time period did not require a college education (Arendale, 2002b). However, when students decided to enroll in postsecondary institutions, the numbers were extremely modest and many students required assistance in the form of developmental education or remediation in academic disciplines, including reading, writing, and mathematics. Developmental education has been a part of the postsecondary educational infrastructure since its beginning; however, the presence of developmental education in historical writings is almost nonexistent, perhaps, due to historians not wanting to paint a gloomy picture of the American education system (Arendale, 2002a; Arendale, 2002b). As the disparity continues to widen between the required skills for higher education and the skills of high school graduates, developmental education is expected to be a mainstay at the postsecondary level (Arendale, 2002b; Boylan, 1999).

Developmental education, sometimes referred to as remedial education, consists of coursework that is designed to give underprepared students the opportunity to improve their academic skills in preparation for college-level work (Bailey, Jeong, & Cho, 2010). However, developmental education is a pipeline that is laden with multiple placement tests in reading, writing, and mathematics that often results in increased time for degree completion (Bailey & Cho, 2010; U.S. GAO, 2013). Today, nearly half of undergraduate students attend community colleges (AACC, 2013) and more than half of those community college students must enroll in at least one developmental education course (Bailey & Cho, 2010; Cohen &
Brawer, 2008). Several studies (Arendale, 2002a; Bailey, Jeong, & Cho, 2010; Achieving the Dream, 2009; Parmer & Cutler, 2007; Stigler, Givvin & Thompson, 2009) indicate that developmental education is necessary in postsecondary educational institutions and continues to increase because more high school graduates are graduating from high school without the necessary academic preparation for college-level work. As the number of students increases who require developmental educations courses at community colleges, costs to provide remedial courses continue to skyrocket. Research conducted by Pretlow and Wathington (2011) indicates that developmental education cost taxpayers $1.13 billion from 2004 and 2005, and the cost continues to rise to meet the needs of the students who require remedial education.

Developmental education provides a clear mission of ensuring that underprepared students are prepared for college-level work, or are “college ready.” However, developmental education is presented with a unique challenge due to the ambiguity of what skills constitute college-ready. According to Latterell and Frauenholtz (2007), college-ready is not clearly defined and there is variation in its meaning on the basis of institutional, state, and program definitions.

According to Arendale (2002a), “postsecondary” institutions have provided remedial and developmental education assistance to underprepared students since the beginning of higher education in the United States. Developmental education was the result of a social change phenomenon that resulted from “major historical events” including economic trends, immigration, public policy, and global impacts (Arendale, 2002b). The changes that confront developmental education are likely to continue as community colleges work to meet the needs of an ever-increasing, diverse student population.
From the mid-1600s to the 1820s, educational institutions in the United States focused on one goal, “replication of postsecondary education from Europe” (Arendale, 2002b, p. 21). These institutions included Harvard (1636), William and Mary (1693), and Yale (1701). Consequently, no assistance was readily available to students who were underprepared for college-level work. The economies of the mid-1600s to the 1820s did not rely heavily on higher education attainment; therefore, higher education institutions were designed primarily to educate the aristocrats of the day. As an increased number of underprepared citizens pursued educational attainment goals, the following subsequent action resulted:

Developmental education in America was created in response to the creation of admission requirements at postsecondary institutions. Nearly all students seeking admission to college were unable to be fully admitted due to deficiencies in the foreign language requirement of Latin and Greek. This is not surprising considering the dismal and nonexistent status of public education. (Arendale, 2002b, p. 7)

During the era following the creation of the first postsecondary institutions, public elementary and secondary schools began to flourish. Postsecondary institutions during this time period were classified as “elitist” and adopted stricter admission criteria that were in excess of the skills acquired by high school graduates of the day (Arendale, 2002b). The resulting disparity between postsecondary admission criteria and the skill level of high school graduates created a certainty that developmental education would continue to be a necessity (Arendale, 2002b). In the early 1800s, the majority of the students who were admitted were underprepared, but because of enrollment management reasons were often admitted in an effort to generate necessary revenue that would prevent institutions from closing their doors.
(Arendale, 2002a). The lenient admission standards that many higher education institutions implemented were “due to the need to sufficiently fund postsecondary institutions” since they received minimal financial support from the local, state, and federal governments (Arendale, 2002b).

Unfortunately, according to Arendale (2002a), the inequality of academic preparation and academic goals would continue to generate the need for developmental education programs at the collegiate level. Historically, developmental and remedial education programs were geared toward educating White males of the day and not underrepresented populations such as women and minorities; however, many women and minorities often required academic bridge programs to ensure their success in college, and this proved that elementary and secondary schools were failing to prepare those students for college-level work.

From the 1860s to the 1940s, community colleges saw the implementation of the First Morrill Act, the Second Morrill Act, funding to predominately black institutions, and an expansion of the junior and community college system (Arendale, 2002b; Dotzler, 2003). According to Arendale (2002b), as the number of institutions and state and local funding increased, the number students also increased; consequently, the need for remedial education programs continued to expand to meet the need of the influx of students.

Today, nearly all postsecondary institutions have some form of developmental education programs aimed at ensuring that underprepared students matriculate and graduate with a college credential (Dotzler, 2003). According to Dotzler (2003), the “goals, behaviors, and challenges of students of the past” are very similar to today’s students.
History of Developmental Mathematics.

Since its inception in the 1600s, postsecondary education has integrated developmental education in the fabric of American education (Arendale, 2002b; Dotzler, 2003). Public education was not prevalent during the early history of the United States; therefore, the majority of students applying to college possessed minimal academic skills. As a result of their deficiency in the basic skills of reading, writing, and arithmetic, many college students were required to enroll in developmental education courses. Developmental education, sometimes referred to as remedial coursework, is defined as coursework at a community college or university that is below “college-level” work and it is this population of students who are underprepared for collegiate work (Achieving the Dream, 2009; Parmer & Cutler, 2007; Stigler, Givvin & Thompson, 2009).

Historically, academically underprepared students have “composed large segments of the collegiate student body” (Arendale, 2002a, p. 17). In some instances, the number of students enrolled in developmental education courses surpassed the number in curriculum courses. Contrary to popular belief, according to Arendale (2002a), developmental education (a) is not a new entity on the educational landscape, (b) is not indicative of worsening academic standards, and (c) helps students to be successful in academic coursework and simultaneously complete college. The history of postsecondary developmental mathematics is innately interconnected with the history of developmental education in the United States.

Developmental Mathematics in the North Carolina Community College System

According to the Commission on the Future of Higher Education’s report, of high school graduates who matriculate at a postsecondary institution, many waste time and money remediating English and math skills that they should have acquired in high school (U.S. DE,
2006), which results in the need to reduce time to completion for millions of community
college students. The Developmental Education Initiative (DEI) is “state-policy initiative”
that was designed to restructure the developmental education offerings within the North
Carolina Community College System (Developmental Education Initiative [DEI], n.d.). The
redesign efforts were put in place to mitigate barriers in developmental education to (a)
accelerate student completion rates; (b) implement diagnostic placement tests; and (c)
increase the number of students who complete developmental education and advance to
curriculum courses (DEI, n.d.).

In higher education, a quarter system equates to 10 weeks and a semester equates to
16 weeks. In 1997, the North Carolina Community College System (NCCCS) switched from
a quarter system to a semester system (Feature: End of the Quarter System, n.d.). The
NCCCS switch from a quarter system to a semester system equated to an additional 6 weeks
in developmental mathematics courses. In fall 2013, the NCCCS, as part of the
Developmental Education Initiative (DEI), converted from traditional 16-week
developmental mathematics courses to 4-week developmental math (DMA) modules.

Prior to 2013, the NCCCS offered the following 16-week developmental mathematics
courses: (a) MAT 050 – Basic Math Skills included properties, rounding, estimating,
converting and computing whole numbers, fractions, and decimals; (b) MAT 060 – Essential
Mathematics included principles and applications of fractions, decimals, percents, ratio and
proportion, geometry, order of operations, and elements of algebra and statistics; (c)
MAT070 – Introductory Algebra included signed numbers, exponents, order of operations,
simplifying expressions, solving linear equations and inequalities, graphing, formulas,
polynomials, factoring and elements of geometry; and (d) MAT 080 – Intermediate Algebra
included factoring, rational expressions, rational exponents, radical and quadratic equations, systems of equations and inequalities, graphing functions, variations, complex numbers and elements of geometry (NCCCS). The grading scale of the MAT sequence included the following grades on a 7-point scale: 93 – 100 = A; 85 – 92 = B; 77 – 84 = C; below 77 = IP (In-progress). A grade of IP is equivalent to repeating the course. No grades of “D” or “F” were assigned in developmental mathematics.

The former 16-week developmental math courses were replaced with the following 4-week modules to expedite student success and completion rates: (a) DMA 010 – Operation with Integers, which includes integers, absolute values, exponents, square roots, perimeter and area of basic geometric figures; (b) DMA 020 – Fractions and Decimals, which includes application of operations and solving contextual applications problems involving fractions and decimals; (c) DMA 030 – Proportions/Ratios/Rates/Percent, which includes rates, ratios, percents, proportions, unit conversions, and applications of geometric concepts; (d) DMA 040 – Expressions/Linear Equations and Inequalities, which include solving contextual application problems, simplifying expression and applying knowledge of problem solving to equations and inequalities; (e) DMA 050 – Graphs and Equations of Lines, which includes slopes, equations of lines, interpretation of basic graphs, and modeling; (f) DMA 060 – Polynomials and Quadratic Applications which includes, polynomial operations, factoring polynomials and solving polynomials by factoring; (g) DMA 070 – Rational Expressions and Equations which includes simplifying and performing operations with rational expressions and equations, understanding domain, and determining the reasonableness of an answer; (h) DMA 080 – Radical Expressions and Equations, which include simplifying and performing operations with radical expressions and radical exponents, solving radical equations, and
determining the reasonableness of an answer. The developmental mathematics redesign has not been a panacea for the challenges that confront developmental mathematics. As a result of the switch to 4-week courses, some North Carolina community colleges experienced challenges with the amount of content in the particular DMA courses and consequently resorted to offering a modified version of the DMAs. DMA 065 – Algebra for Precalculus is such a course. Instead of being a 4-week course, DMA 065 is an 8-week course that essentially combines the content of DMA 060, DMA 070, and DMA 080 to allow developmental mathematics instructors additional time to integrate the content from the three courses. As a result, the instructors can better promote student success in the content-heavy courses of DMA 060, DMA 070, and DMA 080. The focus of the new modularized-format developmental mathematics sequence has shifted to a mastery-approach that equates to 80%. The mastery-approach absolved the traditional grading scale and resorted to the use of two grade outcomes, either P = Pass (80% or higher) or R = Repeat (less than 80%).

**Community College Faculty**

Community colleges vary in their requirements for developmental mathematics faculty. According to Rifkin (n.d.), community college faculty are different than faculty at four-year institutions in that community college faculty represent each degree level, including associate’s, bachelor’s, master’s, doctorate, and professional degrees. Consequently, developmental mathematics faculty at community colleges hold credentials ranging from a baccalaureate to doctoral degrees in education, mathematics, mathematics education and closely related disciplines that contain coursework in mathematics. As a result of the overwhelming variances that exist among developmental mathematics instructors at community colleges related to their educational training, the success of developmental
mathematics students may be jeopardized on the basis of the pedagogical and instructional deficiencies of ill-prepared developmental mathematics instructors (Boylan, 2002; Spradlin & Ackerman, 2010).

According to the American Mathematics Association of Two-Year Colleges (AMATYC, 2014), the association strongly recommends that well-qualified instructors be allowed to teach mathematics because “ill-prepared” faculty can harm students’ knowledge, beliefs, and attitudes towards mathematics. In accordance with the minimal requirements for mathematics faculty at two-year colleges, AMATYC contends that mathematics faculty should possess at least a master's degree in mathematics or in a related field and have at least 18 semester hours (27 quarter hours) in graduate-level courses strongly related to mathematics. Additionally, faculty should have completed course work in pedagogy that supports effective teaching and learning of mathematics. AMAYTC fosters the belief that community college mathematics instructors are reflective, intentional with instruction, and clearly understand the innate nature of mathematics and its relationship to other disciplines. According to AMATYC (2014), effective mathematics instructors understand mathematics at an in-depth level and continually work to develop an understanding of teaching and learning mathematics. Spradlin and Ackerman (2010) indicate that universities and colleges typically hire faculty with high school teaching experience to teach their developmental mathematics students, and instructors must be attuned to altering and improving their pedagogical practices to support the needs of developmental mathematics students.

**Community College Faculty Credentials**

Each community college in the United States is governed by an accrediting body that oversees particular regions in the country (Jenkins, 2008). North Carolina community
colleges are governed and accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACS-COC). According to Alexander, Karvonen, Ulrich, Davis, and Wade (2012), community college instructors or professors teach in 2-year postsecondary institutions, and their primarily focus is teaching, unlike their peers at 4-year, postsecondary institutions whose primary role is research and publication. Typically, to teach at a community college that awards associate degrees, accrediting authorities require faculty members to possess a master’s degree and a minimum of 18 graduate hours in the respective discipline (Jenkins, 2008). Although community college instructors have a master’s degree and 18-graduate hours in the discipline being taught, most community college faculty lack specific training and education coursework in college teaching and learning. At most community colleges in the United States, instructors are not required to be certified as community college instructors.

Comprehensive Standard 3.7.1 of the Principles of Accreditation reads as follows:

The institution employs competent faculty members qualified to accomplish the mission and goals of the institution. When determining acceptable qualifications of its faculty, an institution gives primary consideration to the highest earned degree in the discipline. The institution also considers competence, effectiveness, and capacity, including, as appropriate, undergraduate and graduate degrees, related work experiences in the field, professional licensure and certifications, honors and awards, continuous documented excellence in teaching, or other demonstrated competencies and achievements that contribute to effective teaching and student learning outcomes. For all cases, the institution is responsible for justifying and documenting the qualifications of its faculty (SACSCOC, 2006).
According the Southern Association of Community Colleges Commission on College (SACCOC, 2006):

- Faculty teaching general education courses at the undergraduate level: doctorate or master’s degree in the teaching discipline or master’s degree with a concentration in the teaching discipline (a minimum of 18 graduate semester hours in the teaching discipline);
- Faculty teaching associate degree courses designed for transfer to a baccalaureate degree: doctorate or master’s degree in the teaching discipline or master’s degree with a concentration in the teaching discipline (a minimum of 18 graduate semester hours in the teaching discipline);
- Faculty teaching associate degree courses not designed for transfer to the baccalaureate degree: bachelor’s degree in the teaching discipline, or associate’s degree and demonstrated competencies in the teaching discipline.

The criteria recognized by SACS-COC for postsecondary faculty do not specifically reference or mention pedagogy, teaching, and learning as part of a minimum requirement for instructors employed in colleges that it accredits. Developmental mathematics courses are prerequisite courses for curriculum level mathematics courses and are not awarded credit toward an associate degree, and are not transferable to the baccalaureate level. Therefore, instructors who teach developmental mathematics are not required to possess a master’s degree in the discipline. According to Rifkin (n.d.), the academic credentials of community college faculty vary as a result of the needs of vocational and curriculum students, therefore, the community college faculty will continue to reflect the diverse academic and vocational requirements necessary for community college students. Also, due to the lack of an
adherence to a requirement for community college faculty to have training and education in pedagogy, in addition to expertise in a content area, developmental mathematics students may continue to face hardships in the developmental mathematics classrooms when instructors are not equipped with the pedagogical and instructional tools necessary to best serve that population.

According to Bartlett (2002), equipping postsecondary classrooms with qualified instructors presents a major personnel challenge for many disciplines in education. However, unlike secondary education, information regarding preparing, licensing, and certifying qualified instructors at the postsecondary level is minimal, obscure, and conflicting in nature (Bartlett, 2002). Whereas most secondary instructors are required to complete teacher certification requirements prior to acquiring a license to teach, postsecondary instructors are not required to complete a formal training program that renders them highly qualified.

Elementary, middle school, and high school educators, collectively referred to as K-12, are educated and certified in their respective disciplines on how students learn and how to incorporate research-based pedagogical practices in the classroom, but postsecondary educators often have little or no training in how to teach their disciplines (Barnett & Gunersel, 2014). Bartlett (2002) indicates that “properly prepared and qualified CTE instructors are needed to educate and train students to be productive”, and a similar belief can be applied to non-CTE, postsecondary disciplines (p. 2). Within the confines of career and technical education (CTE), there are a multiplicity of options postsecondary instructors can use to acquire licensure or certification, and many vary from state to state.

Bartlett (2002) indicates that postsecondary CTE instructors work with a diverse student population; therefore, they should be versed in both “pedagogy and andragogy”.” On
the basis of this research on CTE instructors, a similar line of reasoning can be used to infer the necessity that developmental mathematics instructors should also be versed in pedagogy and andragogy on the basis of similar student populations. While postsecondary instructors are not required to possess specific licenses or credentials to teach, Bartlett (2002) contends that “in addition to the knowledge of learning theories, teachers should have an understanding of development of curriculum and instruction, delivery of instruction, assessment of students, and evaluation of programs” (pp. 5 – 6).

Preparing Postsecondary Developmental Math Instructors

It is imperative that developmental mathematics instructors have access to professional development in the form of training, reading research, and conferences and workshops that allow them to acquire more knowledge about developmental education students (Boylan, 2002; Spradlin & Ackerman, 2010). Bartlett’s (2002) research indicates that educators need to possess an understanding of learning theory, modalities of instruction, and assessment. There is a major similarity between the postsecondary career and technical educator and the postsecondary developmental mathematics instructor. According to Bartlett (2002), the majority of postsecondary career and technical educators are not required to complete a formal teacher preparation or licensure curriculum. Similarly, developmental mathematics instructors at postsecondary institutions are not required to complete a formal preparation process to teach in postsecondary institutions. Although career and technical and developmental mathematics instructors may be content experts, their expertise in teaching and learning is often lacking and puts students at a disadvantage in the classroom. Bartlett (2002) indicates that career and technical instructors work with diverse groups of students on
multiple skills levels and that consequently, these instructors need to be versed in pedagogy and andragogy.

Postsecondary institutions are confronted with the task of ensuring that career and technical faculty appointments are filled by individuals who have adequate academic preparation and are qualified to provide quality instruction (Bartlett, 2002). However, the challenge of outfitting career and technical classrooms is an ongoing one that also impacts other disciplines at postsecondary institutions (Bartlett, 2002). Although it is not a career and technical discipline, developmental mathematics impacts career and technical disciplines as a result of the role of mathematics in career and technical disciplines. In accordance with the expectation that career and technical faculty be qualified to provide quality instruction (Bartlett, 2002), developmental mathematics instructors are also expected to adhere to teaching standards that promote and ensure student success.

**Faculty Characteristics Impact on Student Success**

Quantitative research has been conducted on specific faculty characteristics including age, gender, educational preparation, teaching experiences and employment status (part-time or full-time), and their impact on student success in postsecondary institutions (Penny & White, Jr., 1998). In a study by Goldhaber and Brewer (1996) that surveyed roughly 24,000 8th graders, they found that teachers who were certified in mathematics and who held an undergraduate or graduate degree in mathematics reflected higher student performance than those without such credentials. The research appears to support the claim that the academic credentials of mathematics instructors can impact student success outcomes in developmental mathematics courses at a community college. Although the claim is made that the credentials of mathematics instructors impact the success of the students, the exact level of
impact is uncertain. This research investigates the pedagogical practices, classroom environments, and the educational ideologies of the developmental mathematics instructors and their impact on student success in developmental mathematics.

Previous research by Hanushek (1986) indicates that the effects of educational inputs, such as per pupil spending, teacher experience, and teacher degree level have been shown to be relatively unimportant predictors of outcomes, and the impact of any particular input to be inconsistent across studies. Subsequent research by Goldhaber and Brewer (1996) indicates that student performance in mathematics is closely related to the certification status and academic degree of the instructor. Due to the disparity in such research conclusions, additional research is needed to assess the impact that the academic credentials of developmental mathematics instructors may have on the success of developmental mathematics students. Research studies have been done that relate students’ performance to faculty and student attributes. The faculty attributes included faculty age, gender, educational preparation, teaching experience and employment status, and the student attributes included age, gender, ethnicity and enrollment status (Penny & White, Jr.,1998). The impact of community college faculty credentials on the success of students in developmental mathematics courses has not been addressed specifically in the literature. This study will investigate the impact of community college faculty credentials on the success of students in developmental mathematics.

**The Developmental Mathematics Classroom**

In the 1960s, researchers conducted extensive research in developmental education as it relates to teaching and learning; however, classroom practices have remained relatively unchanged with the exception of the introduction of widespread technology use (Dotzler,
Recent research reveals that a severe misalignment exists between instructors’ teaching style and students’ learning styles, which results in students not being engaged and learning course material (Borg & Shapiro, 1996; Lage, Platt, & Treglia, 2000). In order to promote and sustain student engagement and success, instructors must diversify their approach to teaching and learning. Classes that incorporate diverse teaching styles are inclined to experience overall student success and performance (Lage, Platt, & Treglia, 2000). According to Lage, Platt, and Treglia (2000), the use of multimedia for both students and instructors is a sure way to mitigate challenges that result from the disparity in instructors’ teaching approaches and students’ diverse learning styles. Recent research by McDaniel and Caverly (2010) reveals that one approach to improve the developmental mathematics classroom is by use of the inverted classroom model. As opposed to the traditional lecture approach to teaching developmental mathematics, the class is flipped to incorporate a video lecture to present the material to students before class and during class. Students can actively engage in student-to-student and student-to-instructor exchanges.

**Developmental Mathematics Instruction.**

Developmental mathematics courses have traditionally been taught using a traditional lecture format (Armington, 2003; Maxwell, 1979). However, increased access and interest in technology and computers have allowed mathematics educators to integrate both computers and learning software technology into classrooms to improve student success in developmental mathematics courses. According to Brothen and Wambach (2002), integrating computers into instruction is more impactful than stand-alone traditional instruction. Spradlin and Ackerman (2010) explain in a quasi-experimental study that compared the performance of students who were taught developmental mathematics via a
traditional format versus a traditional format coupled with computer based instruction, there appeared to be no significant difference between the two populations. The study also revealed that the mere presence of technology does not automatically equate to improved student success. Although computers have the capability to improve learning, the particular software program used to supplement traditional teaching is instrumental to accommodate the learning modalities of developmental mathematics students (Spradlin & Ackerman, 2010). Teaching developmental mathematics without considering other factors that impact student success is not sufficient (Hall & Ponton, 2005; Perez, 1998). According to Spradlin and Ackerman (2010), “math anxiety, negative attitudes, poor study skills, and lack of responsibility should also be addressed” in conjunction with the format of the developmental mathematics class (p. 12).

A few studies (Armington, 2003; Perez, 1998) indicate that traditional mathematics courses are incorporating teaching methods that use conceptual understanding, active learning, and contextual learning in support of student engagement, understanding, and success. Additional studies call for the integration of technology into classroom to enhance and promote student learning and success (AMATYC, 1995; NCTM, 2000).

Supplemental Instruction (SI) was introduced in 1973 and is a peer-assisted study session that helps students in academic coursework by integrating and developing learning and study strategies. One of the main outcome goals of SI is to improve student success. Supplemental instruction is an “academic support used to aid student performance, retention, and academic success” (Phelps & Evans, 2006, p. 35).
Developmental Mathematics Instructional Formats

Developmental mathematics has traditionally been taught using a traditional, lecture-based format (Armington, 2003; Maxwell, 1979; Zhu & Polianskaia, 2007). In the traditional lecture format, the instructor assumes the sage-on-the-stage role and provides face-to-face instruction in very structured lectures. In the traditional format, instructors pose questions to students in order to invoke engagement and students subsequently answer questions. Additionally, the lecture format entails providing practice problems for students to ensure understanding and mastery of specific concepts. However, Bonham and Boylan (2011) posit that offering a variety of instructional formats for developmental mathematics is paramount to ensuring student success.

Juxtaposed to the traditional lecture format is the use of computer-mediated mathematics instruction in developmental mathematics courses. The computer-mediated instructional format entails integrating interactive, multimedia computer software as the primary mode of instruction that corresponds to individual learning styles and levels of skill deficiency (Zhu & Polianskaia, 2007). Instead of the instructor serving as the sage-on-the-stage who simply disseminates information, the computer-mediated approach shifts the focus of instruction from an instructor-led approach to a facilitative approach that helps individual students with specific concepts.

According to Zhu and Polianskaia (2007), students typically prefer either the traditional lecture or computer-mediated format on the basis of individual student preferences. Research by Kinney (2001) indicates that students prefer the traditional lecture format over the computer-mediated format on the basis of the human interaction and being able to ask questions from instructors and receiving immediate feedback. The traditional
lecture format is an ideal format to incorporate cooperative and active learning experiences. Cooperative and active learning are classified as best practices in developmental education. As indicated by Cafarella (2016), developmental mathematics instructors have witnessed the impact that cooperative learning plays in promoting student success. Woodward (2004) contends that cooperative learning promotes students’ sense of connection within the group and alleviates mathematics anxiety.

According to Kinny (2001), the use of computer-mediated instruction is the preferred delivery format for many students. Developmental mathematics has experienced an increase in the use of computer-mediated instruction as a means to support and promote student success. Some students prefer computer-mediated instruction because their learning styles and preferences warrant the use of multimedia instead of working face-to-face with an instructor. The computer-mediated format is also often preferred because it is more engaging than an instructor, it allows students to work at their own pace, and multimedia gives immediate feedback.

Although traditional lecture and computer-mediated instructional formats are available for developmental mathematics courses, research by Baker, Hale, and Gifford (1997) claims that the computer-mediated format has experienced higher success rates. As a result of the higher success rates experienced by students using the computer-mediated format, as developmental mathematics instructors seek to improve overall success rates, computer-mediated instruction will certainly continue to serve as a viable option for developmental mathematics programs.
Best Practices in Developmental Mathematics.

“Mathematics is the universal enabling discipline, which underpins the physical sciences, chemistry, biology, modern technology, and the global economy” (Zhu, & Polianskaia, 2007, p. 63). Therefore, acquiring mathematics skills and being successful in mathematics are important success factors in higher education. According to Cafarella (2016), best practices in developmental mathematics abound. Learners in the developmental mathematics classroom are diverse learners. Developmental mathematics has traditionally been taught using a traditional lecture format (Armington, 2003; Maxwell, 1979; Zhu & Polianskaia, 2007), however, according to Bonham and Boylan (2011), the successful developmental mathematics instructor must utilize a multiplicity of approaches to teach and promote student success.

One such best practice is the use of cooperative learning. According to Cafarella (2016), many developmental mathematics instructors have witnessed the positive impact of the cooperative learning strategy. Woodward (2004) contends that cooperative learning promotes students’ sense of connection within the group and alleviates mathematics anxiety. According to Hiltz (1998), collaborative learning or active learning refers to instructional approaches that encourage students to work together on academic tasks. Collaborative learning is essentially different than pure lecturing as the standard medium of sharing information and knowledge. A collaborative learning environment allows the instructor to promote active learning and engagement and students filter new knowledge through their contextual experiences that make learning more impactful and relevant. In support of cooperative learning, Boylan (2002) indicates that cooperative learning promotes the
development of critical thinking skills, which are desperately needed by all students, not just developmental education students.

Research in developmental mathematics contends that a specific structure must be present in the developmental mathematics classroom (Vasquez, 2003). A developmental mathematics instructor’s overall structure in the classroom serves as a best practice. Vasquez (2003) stresses the importance of using the Algorithm Instructional Technique (AIT) when presenting material to developmental mathematics students. The AIT is essentially a step-by-step approach to solving particular math problems and helps minimize stress associated with solving math problems. After modeling how to solve particular problems, students should be given the opportunity to solve similar problems and receive timely feedback (Cafarella, 2016; Vasquez, 2003).

Effective note-taking is another best practice that can be used by developmental mathematics instructors. According to Cafarella (2016), some developmental mathematics instructors attribute student success in developmental mathematics to the study skill of note-taking. Effective note-taking has been associated with improved short-term and long-term memory of lectures which further supports performance on assessments. Issacs (1994) contends that a positive correlation exists between quality notes, the review of such notes, and students’ performance on exams.

The inclusion of instructional games and activities is also a useful instructional best practice that supports student success (Cafarella, 2016). Historically, instructors have taught developmental mathematics courses by using a traditional lecture format (Armington, 2003; Maxwell, 1979). Today, incorporating instructional best practices into developmental
mathematics instruction is paramount to ensure the success of developmental mathematics students in community colleges.

Several studies (Brothen & Wambach, 2002; Bonham & Boylan, 2011) posit the incorporation of technology and computers in the developmental mathematics classroom. Bonham and Boylan (2011) also contend that best practices in the developmental mathematics classroom consist of (a) merging classroom and lab instruction, (b) offering a variety of course formats, (c) integrating project-based learning, (d) ensuring proper assessment and placement, and (e) providing ongoing professional development for faculty on best practices in teaching and learning.

**Andragogy**

Andragogy is a term associated with the work of Malcolm Knowles in the 1960s and 1970s. Andragogy is defined as teaching and learning processes associated with adults, whereas pedagogy is defined as teaching and learning processes associated primarily with children (Merriam & Brockett, 2007). Although initially thought of as polar opposites in teaching and learning, pedagogy and andragogy are now considered part of a learning spectrum that is dependent upon the particular learning situation (Merriam & Brockett, 2007). According to Erklenz-Watts, Westbay, and Lynd-Balta (2006), although teaching is a primary role for college instructors, few postsecondary disciplines provide professional development on how to teach. Most professional development on pedagogy for college instructors comes in the form of one day in-service trainings that do not effectively support good pedagogy. Elementary, middle school, and high school educators (K-12) are educated and certified in their respective disciplines on how students learn and how to incorporate research-based pedagogical practices in the classroom, but postsecondary educators have
little or no training on how to teach their disciplines (Barnett & Gunersel, 2014).

Postsecondary leadership officials are considering approaches to provide continual professional development opportunities to assist faculty in integrating innovative and engaging teaching methodologies (Kim, Cho, & Svinicki, 2011). The lack of pedagogical training and an understanding of how students learn can negatively impact how community college mathematics faculty instruct developmental mathematics students.

The best methodology for teaching entails the integration of pedagogical approaches that correlate to a student’s learning style. However, historically, educational institutions have utilized the “lecture method” to provide instruction, which is essentially geared toward the auditory learner; however, other learning styles exist. Many educators in higher education continue to utilize the traditional method of instruction, namely, the lecture approach. According to Cafarella (2016), developmental mathematics faculty must incorporate a diversity of strategies and techniques that allow the “homogenous” group of learners to succeed (p. 55). The teaching profession and its approach to imparting information to students has largely remained unchanged. In the 1970s, the use of a projector, tape recorder, camera, and other technology of the day created anxiety in seasoned, lecture-style teachers who were not interested in integrating new methods of teaching that aligned with the diverse learning styles of students (Zoe, 2000). In a lecture format, the instructor presents information that he or she will later ask students to mimic in the form of an assessment; consequently, often, no real learning takes place because students are passively learning, and many instructors are satisfied with the status quo (Zoe, 2000).

According to McCarthy and Anderson (2000), human interaction is at the “heart” of learning and education, yet most educators at the postsecondary level expect students to
acquire the necessary skills with little, if any, interaction with their classmates or facilitator. Students who are engaged in active-learning environments, per the findings of McCarthy and Anderson (2000), are more actively engaged in classes than students in traditional lecture classes which leads to higher graduation rates. According to Hiltz (1998), collaborative learning or active learning refers to instructional approaches that entail students working together on academic tasks. Collaborative learning is essentially different than pure lecturing as the standard medium of sharing information and knowledge. A collaborative learning environment allows the instructor to promote active learning and engagement, and students filter new knowledge through their contextual experiences that make the learning more impactful and relevant.

**Mathematics Anxiety**

Mathematics anxiety is “a negative emotional reaction to situations involving mathematical problem solving” that may have a negative impact on overall success (Young, Wu, & Menon, 2012, p. 492). Student success can be severely compromised in the presence of test anxiety and must be addressed to ensure student success (Maxwell, 1998). Rubinsten and Tannock (2010) indicates that math anxiety impacts the learning of mathematics from an early age. According to Spradlin and Ackerman (2010), “math anxiety, negative attitudes, poor study skills, and lack of responsibility should also be addressed” in conjunction with the format of the developmental mathematics class.

**Barriers to Student Success In Developmental Mathematics**

There are numerous challenges that thwart students’ success in academia (Cafarella, 2016). According to Maxwell (1998), mastering time management, test-anxiety, and note-taking skills are an integral part of promoting and ensuring student success. There are many
implied causes of dismal student success rates in developmental mathematics courses, including students’ lack of preparation, students’ lack of interest in mathematics, students’ lack of foundational instruction, and students’ lack of support from their institutions. Additionally, some developmental mathematics courses lack content relevance and lack sufficient technological resources (Bonham & Boylan, 2011; Cafarella, 2016).

Student success in developmental mathematics strongly correlates to regular class attendance. According to Cafarella (2016), student attendance in developmental mathematics courses is a major student success factor. Students who do not attend class regularly are more likely to perform poorly in developmental mathematics due to the linearity of the mathematics (Boylan, 2011). Promoting consistent attendance requirements in developmental mathematics courses is paramount to promote and ensure student engagement and success.

Cafarella (2016) posits that developmental mathematics students are also faced with challenges that result from apathy, which results in higher non-completion or failure rates. He also contends that many developmental mathematics students simply lack the intrinsic motivation to be successful. Higbee and Thomas (1999) indicate that students’ lack of motivation and their overall negative outlook severely impacts their performance in developmental mathematics courses. The lack of student motivation and a negative attitude toward mathematics creates a perpetual cycle that results in students being unsuccessful in developmental mathematics courses (Cafarella, 2016). Community colleges are enrolling an increasing number of underprepared students (Achieving the Dream, 2009; Parmer & Cutler, 2007; Stigler, Givvin & Thompson, 2009; U.S. GAO, 2013). Coupled with under-
preparedness, research also contends that students’ poor work habits are innately connected with poor performance in developmental mathematics courses (Cafarella, 2016).

According to Johnson, Rochkind, Ott, and DuPont (2009), 60% of community college students work full-time to support themselves and their families, which results in lower graduation rates. According to Cafarella (2016), “employment obligations” serve as another barrier to student success in developmental mathematics (p. 58). Many community college students work full-time, and their efforts to balance work, family, and school can be overwhelming and lead to suffering grades in developmental mathematics courses (Immerwahr, J., Friedman, W., & Ott, A. N., 2005).

Summary

Each year, a growing number of underprepared students enroll in the community colleges across the nation. Of the students who enroll in developmental education, a disproportionate number place into developmental mathematics courses. Extensive research has found that developmental mathematics courses serve as a gatekeeper course that prevents many students from advancing to curriculum level mathematics courses, which ultimately results in students failing to complete a college credential. The absence of a college credential disqualifies many students from many 21st century jobs.

Student success in developmental mathematics courses continues to be a concern for students, educational professionals, policy makers, and postsecondary leaders across the nation. This literature review investigates the instructional strategies of the developmental mathematics instructors through the lens of Astin’s Input-Environment-Output model. The results of the study will advance the current knowledge in the field of developmental mathematics by focusing on the instructional strategies utilized by developmental
mathematics instructors at the community college level as a means to further support and improve overall success rates in developmental mathematics at the postsecondary level. While there are a multiplicity of factors that impact student success in developmental mathematics, both affective and cognitive, this research study focused primarily on the instructional strategies employed by the developmental mathematics instructors delineated by the academic credentials of developmental mathematics instructors.

The literature clearly supports the claim that postsecondary mathematics instructors should be versed in pedagogy and instruction strategies that support the diverse learning styles of students. Quantitative research has been done on several personal and professional attributes of developmental mathematics faculty, including age, gender, employment status, instruction, and academic credentials. This research study investigates the specific instructional strategies employed by developmental mathematics faculty on the basis of their academic credentials to evaluate student success in developmental mathematics courses.
CHAPTER THREE: METHODOLOGY

Overview

According to Marshall and Rossman (2006), qualitative research has become an important method to answer questions raised in applied fields such as education. On the basis of acquiring insight, discovery, and interpretation into an educational phenomenon, the qualitative case study is an appropriate methodology to investigate educational phenomenon (Merriam, 1988). The purpose of this qualitative case study is to explore how the educational credential of a developmental mathematics instructor impacts the success of developmental mathematics students at a community college. The developmental mathematics classroom is shaped by the developmental mathematics instructor’s knowledge of teaching and learning, attitude, beliefs, and experiences. The success of the developmental mathematics student depends on his or her ability to master developmental mathematics content, along with acquiring self-efficacy, self-regulation, and a mechanism to proactively deal with mathematics anxiety. Mastering developmental mathematics content and acquiring the necessary affective domain attributes that impact student success are either supported or diminished by the developmental mathematics instructor. This research study sought to answer the following questions related to the academic credentials of developmental mathematics faculty and the success of students in developmental mathematics courses at a community college.

RQ1: What are the pedagogical practices of developmental mathematics instructors who have either a mathematics education or mathematics (non-education) degree?

RQ2: How are the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree
similar to developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ3: How are pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree different than those utilized by developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ4: How do the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who report high student pass rates differ from developmental mathematics instructors who do not have high pass rates?

This chapter provides an outline of the study’s research methodology, research design, sample selection, data collection techniques, data analysis, validity and reliability, and the researcher’s bias and ethical views.

**Design of the Study**

Research is defined as “systematic inquiry” and case study is used to systematically study a phenomenon (Merriam, 1988, p. 6). Merriam and Simpson (1995) posit that research is the avenue through which a discipline expands, informs, and enhances practice. According to Merriam (1988), “a descriptive case study in education is one that presents a detailed account of the phenomenon under study” (p. 27), and this research proposes to give an in-depth account of the developmental mathematics instructor as the case in a qualitative case study. The research design utilized in this case study will be descriptive (nonexperimental) and comparative in nature on the basis that “description and explanation rather than prediction based on cause and effect are sought” are the intended goals of the study (Merriam, 1988, p. 7).
Understanding the impact that a developmental mathematics instructor’s credential has on student success in developmental mathematics courses is a critical problem of practice in the community college. Gaining insight into the phenomenon can have a lasting and an indelible impact on establishing proactive ways to help students to be successful in developmental mathematics courses. In this research design, the “case” as defined in the qualitative case study will be the developmental mathematics instructor in accordance with their role in the success of students enrolled in developmental mathematics courses. Gaining an explicit understanding of the impact that the faculty credentials of a developmental mathematics instructor have on the success of students in developmental mathematics courses establishes a qualitative perspective that implies that multiple realities exist and “the world is not an objective thing out there, but a function of personal interaction and perception” that benefits from interpretation, not mere measurement of a phenomenon (Merriam, 1988, p. 17). Due to the critical nature of the problem proposed in this study, a qualitative case study is particularly suitable for research that focuses on establishing “insight, discovery, and interpretation rather than hypothesis testing” for critical problems of practice (Merriam, 1988, p. 10). Using a descriptive, qualitative case study allows the researcher to systematically investigate the impact that faculty credentials have on student success in developmental mathematics courses by investigating the instructional and pedagogical practices used by developmental mathematics instructors. On the basis of the research findings, operational processes designed to improve student success in developmental mathematics may be implemented at the institutional level to include: modifying hiring practices for developmental mathematics instructors, implementing innovative instructional strategies to be used in developmental mathematics courses, and
providing ongoing professional development opportunities for developmental mathematics instructors.

According to Yin (2014), a case study is applicable to a research design that incorporates the elements of question types that include “how” and “why”, lacks control over behavioral events, and investigates a contemporary issue. Gaining an understanding of the impact that faculty credentials have on student success in developmental mathematics courses is suitable as a case study on the basis that it seeks to investigate both a contemporary and contextual problem, the researcher has no control of the variables in the phenomenon, and the research questions posed in the study seek to answer “why” and “how” interrogatives. This research study utilizes qualitative data collected from interviews and focus groups to respond the research questions.

**Case Study Methodology**

The field of education provides a multiplicity of opportunities to pose questions on how to improve the practice of education. A case study research methodology approach results from the intention to comprehend “complex social phenomenon” and seeks to investigate bounded, contemporary phenomenon in-depth via “real-world” context (Yin, 2014, p. 4). A qualitative case study is indicative of the following attributes: (a) particularistic focus on an specific event, person, program or phenomenon; (b) a descriptive end product of the research study provides a rich, “thick” account of the phenomenon under investigation; (c) through a heuristic analysis, the research study expands the reader’s understanding of the phenomenon; and (d) inductive, overarching generalizations and hypotheses result from the research study (Merriam, 1988; Merriam & Simpson, 1995). Case study is an appropriate methodology for this research initiative because “the case study is
preferred in examining contemporary events” (Merriam, 1988, p. 8) within real-world context (Yin, 2014). Unlike an experimental research design that manipulates “variables of interest” and investigates the cause-and-effect relationships, case studies are designed to investigate complex scenarios involving multiple variables that are outside the researcher’s control (Merriam, 1988, p. 6).

According to Yin (2014), a case study is applicable to a research design that incorporates the elements of question types that include “how” and “why”, lacks control over behavioral events, and investigates a contemporary issue. Merriam (1988) posits that a qualitative case study is an “intensive, holistic description and analysis of a bounded phenomenon,” such as a program, an event, a person, a process, an institution, or a social group (p. 9). Case study methodology as a qualitative research paradigm, juxtaposed to a quantitative research paradigm, identifies with processes rather than particular outcomes, contextual scenarios over a particular variable, and discovery of innovative information as compared to confirmation of a hypothesis or theory (Merriam, 1988).

Most case study research in education addresses practical problems holistically in its effort to obtain an “in-depth” understanding of a particular case (Merriam, 1988). The case study methodology is the best approach for understanding problems in the educational arena and while simultaneously working to improve the profession (Merriam, 1988). This research study entails gaining an understanding of the impact that faculty credentials of developmental mathematics instructors have on the success of students in developmental mathematics courses. It is suitable as a case study on the basis that it seeks to investigate both a contemporary and contextual problem, the researcher has no control of the variables in the
phenomenon, and the research questions posed in the study seek to answer “why” and “how” interrogatives.

According to Merriam (1988) and Merriam and Simpson (1995), a qualitative case study relies primarily on qualitative data collected from interviews, observations, and document analysis. This research design will rely heavily on qualitative methods of interviews, observations, and document analysis to gain insight into the research questions in order to establish an in-depth understanding of the impact that faculty credentials of developmental mathematics instructors have on the success of developmental mathematics students. Merriam (1988) indicates that “case study research, and in particular qualitative case study, is an ideal design for understanding and interpreting observations of educational phenomena” (p. 2). Developmental mathematics instructors at a particular community college in the North Carolina Community College system who possess undergraduate and graduate degrees in mathematics and mathematics education respectively represent the educational phenomena in this research study.

Interviews.

According to Merriam and Simpson (1995), the interview is an information gathering technique that “adds a dimension to the data gathering” that other approaches lack (p. 150). The intention of the research collected in this qualitative study is inherently designed to understand student success in developmental mathematics courses from the perspective of the developmental mathematics instructor. Interviewing is a fairly common method used by researchers to collect qualitative data (Merriam, 1988), and case study research relies heavily on this methodology of data collection. Interviewing is a form of conversation (Marshall & Rossman, 2006). Conducting in-depth interviews with developmental mathematics
instructors within the North Carolina Community College System (NCCCS) will provide a way to understand student success from the vantage point of the developmental mathematics instructor. Face-to-face interviews entail the researcher talking to individual participants. According to Yin (2014), “The nature of the interview is much more open-ended and an interviewee may not necessarily cooperate in sticking to your line of questions” (p. 88).

The interview, according to Merriam (1988), is an effective means to gather information that a researcher cannot readily observe and allows the researcher to find out what is “in and on someone else’s mind” (p. 72). There are two types of interviews used in qualitative research methodology, structured and unstructured (Merriam & Simpson, 1995). This research will incorporate the use of a semi-structured interview format to ensure consistency from one interview to the next and will allow participants to share their individual and in-depth perspectives on the protocol questions.

Prior to beginning the interviews, developmental mathematics instructors at the research institution were contacted via email and asked to volunteer to participate in a face-to-face interview. The instructors were given a set amount of time to express their interest in participating in the study. After volunteers were chosen for the study from the initial request, a formal invitation letter was sent to each participant detailing the study, its significance, and their role in the study. Preliminary information regarding each participant’s background and educational credentials were collected via a Google document prior to the face-to-face interview to confirm that each participant met the set forth criteria. After general introductions, the interview were guided by a set of established protocol interview questions. The subsequent portion of the interview focused on establishing each participant’s perception of developmental education, developmental mathematics, and personal instructional
strategies to support student success. A copy of the interview guide will be provided. All
interviews were digitally recorded to ensure accuracy and correct transcription. During the
individual interviews, a semi-structured interview format was utilized to allow instructors to
articulate their views based on the protocol questions.

**Focus Groups.**

According to Jupp (2006), focus groups are an important source of data in qualitative
research because focus groups enable the researcher to intimately learn “about the thoughts
and experiences of other” (p. 121). Focus group interviews allow the researcher to study
participants in a natural setting that is “more relaxed than a one-to-one interview” (Marshall
& Rossman, 2006, p. 114). In accordance with the research questions proposed by the study,
additional participant feedback was gathered through a scheduled focus group of
developmental mathematics instructors who possess either an undergraduate or graduate
degree in mathematics or mathematics education. The focus group sought to delineate the
similarities and differences of the two groups of developmental mathematics instructors to
assess the pedagogical and instructional strategies used by each instructor type as a means to
foster student success in developmental mathematics courses. The focus group also allowed
the developmental mathematics instructors to speak collectively about their views on
teaching developmental mathematics, developmental mathematics students, and student
success strategies that work and do not work with developmental mathematics students. The
focus group session was digitally recorded for later analysis. An invitation flyer was used to
solicit developmental mathematics instructors to participate in the focus group. The focus
group was conducted after the individual interviews and include many of the individual
interview participants.
Sample Selection

Data collection commences with the selection of an appropriate site to conduct the research study and the selection of research participants (Maxwell, 2005). Case study methodology can entail both probability and non-probability sampling techniques (Merriam, 1988). However, qualitative case study research primarily utilizes a non-probabilistic strategy that is purposive in its nature. Purposive sampling is also referred to as “criterion-based sampling” and requires that the researcher establish the standards for which participants are either included or excluded from a research study (Merriam, 2008, p. 48). “The logic and power of purposeful sampling lies in selecting information-rich cases [emphasis added] for study in depth” (Patton, 2002, p. 230). Therefore, according to Merriam (1988), the qualitative researcher should choose a sample base that allows the researcher to learn the most. Maxwell (2005) indicates that the sample used in qualitative research should include specific “times, settings, and individuals that can provide you with the information that you need to answer your research questions” (p. 88).

Unique-case selection was the strategy used to identify the research institution. Based on the 2015 North Carolina community college performance measures, institutions with an overall success rate of 75.4% in the initial curriculum mathematics course after the last developmental mathematics course is classified as “system excellence level” and institutions with an overall success rate of 63.6% in the initial curriculum mathematics course after the last developmental mathematics is classified as “system average.” Unique-case selection for the research institution complements criterion-based sampling of instructors that meet pre-determined criteria.
According to Rifkin (n.d.), community college faculty are different than faculty at four-year institutions in that community college faculty represent each degree level, including associate’s, bachelor’s, master’s, and doctoral degrees. Consequently, developmental mathematics faculty at community colleges hold credentials ranging from a baccalaureate degree to doctoral degrees in education, mathematics, mathematics education, and closely related disciplines that contain coursework in mathematics. As a result, due to the variation of academic credentials that exist among community college developmental mathematics instructors, the success of developmental mathematics students may be negatively or positively impacted on the basis that faculty may either possess or lack pedagogical training in mathematics. Developmental mathematics faculty within the North Carolina community college system are employed on the basis of their attainment of an undergraduate or graduate degree in either mathematics or mathematics education.

For this research study, a criterion-based sample selection strategy known as the quota sample will be used to select instructor participants for the research study. The quota selection, according to Merriam (1988), involves the selection of an arbitrary number of developmental mathematics instructors who meet specified selection criteria. Yin (2014) indicates that “prior to collecting the screening data, you should have a defined set of operational criteria whereby candidates will be deemed qualified to serve as cases” (p. 94).

In order to complete this research study, the institution used to investigate the impact of faculty credentials on student success in developmental mathematics must consist of a diverse developmental mathematics faculty. The faculty will encompass individuals who have academic credentials to include either an undergraduate or graduate degree in mathematics or mathematics education. The training of developmental mathematics faculty
will vary depending on the academic credential earned. Developmental mathematics faculty who possesses a degree in mathematics without a concentration in education are equipped with the technical mathematics skills that qualifies them to teach based on the content. Developmental mathematics instructors who possess a mathematics degree with a concentration in education will possess both the technical skills in mathematics, along with the pedagogical skills that equip them with a skill set in teaching and learning diverse learners. The academic credentials earned by the developmental mathematics instructor may make the difference between students experiencing major setbacks in developmental mathematics and experiencing a paradigm shift in developmental mathematics which translate into overall student success. Years of teaching experience will not be part of the selection criteria of developmental mathematics faculty; however, years of teaching experience may represent a rationale for student success in developmental mathematics. After receiving approval for the study by the institutional review board (IRB), the search for a suitable research institution that meets the selection criterion commenced. After the research institution was selected and agreed to host the research study, the recruitment of both individual interview participants and focus group participants began simultaneously using an electronic invitation. Data collection was conducted at the chosen research institution upon attaining the suitable interview and focus group participants who satisfied the established criteria.

The performance measures for student success were used to identify a research institution whose student success rating in developmental mathematics exceeded the system average of 63.6%. A North Carolina community college was chosen as the research site based on its 2015 performance measure of students’ success rate in the first curriculum math
class after the last developmental mathematics. Developmental mathematics instructor participants were chosen on the following criteria:

- **Education**: the participant possesses either an undergraduate or graduate degree in mathematics or mathematics education
- **2015 Performance Measure**: the participant institution has 2015 math performance measures scores higher than the North Carolina Community college system average
- **Position**: participant currently teaches developmental mathematics at a North Carolina Community college

Volunteer participants were selected on the basis of the established criteria: self-identifying as a current developmental mathematics at the research institution, and possessing an academic credential in either mathematics or mathematics education at either the undergraduate or graduate level. Developmental mathematics faculty were interviewed based on their academic credential in either mathematics or mathematics education.

Individual interviews were conducted for seven developmental mathematics instructors to acquire an in-depth view of developmental education, developmental mathematics, developmental education students, teaching and learning, and andragogy from developmental mathematics instructors. A similar configuration of protocol questions will also be used to conduct the focus group sessions.

**Criterion sampling.**

The first criterion used in this research study is that each participant possesses either an undergraduate or graduate degree in mathematics or mathematics education. According to SACSCOC (2006), faculty members teaching transferable general education courses in community colleges are required to possess a doctorate or master’s degree in the teaching
area with a minimum of 18 graduate hours in the discipline. Developmental mathematics
courses are prerequisite courses for curriculum level mathematics courses, are not awarded
credit toward an associate degree, and are not transferable to the baccalaureate level.
Therefore, instructors who teach developmental mathematics are not necessarily required to
possess a master’s degree in the discipline. It is on this basis that developmental
mathematics instructors interviewed in this study may have either the undergraduate or
graduate degree in mathematics or mathematics education.

The second criterion is that participants in the study be currently employed at a North
Carolina community college.

The third criterion is that the research institution be recognized as an institution
whose 2015 performance measures in developmental mathematics exceeded the North
Carolina system average. The Performance Measures for Student Success Report (2015) is
the North Carolina Community College System’s major accountability document. The
annual performance report is based on data compiled from the previous year and serves to
inform colleges and the public on the performance of the 58 North Carolina community
colleges. In the 2015 Performance Measures for Student Success Report, the system
excellence level was 75.4%, the system baseline was 47.5% and the average college
percentage was 63.6%.

Data Collection

In case study research, the researcher serves as the primary instrument of data
collection and analysis (Marshall & Rossman, 2006; Merriam, 1988; Maxwell, 2005).
Qualitative researchers use in-depth interviews are a primary strategy used to collect data
(Marshall & Rossman, 2006). “In case study research of contemporary education, some and occasionally all of the data are collected through interviews” (Merriam, 1988, p. 71).

In addition to in-depth interviews, this research study will also collect data via focus group interviews and a review of documents. According to Yin (2014), using a variety of data collection techniques allow the researcher to develop “converging lines of inquiry” (p. 120). Although single sources of evidence can be used in a research study, it is not advisable when doing case study research (Yin, 2014).

This research project collected information from the developmental mathematics faculty as focus group participants and as individual developmental mathematics faculty via in-depth interviews. Structured interview questions, regarding developmental mathematics, developmental education, developmental students, pedagogy, and student success strategies were used to assess the strategies that uniquely ensure and promote the success of developmental mathematics students. These interview questions are key to gaining an understanding of the phenomenon (Maxwell, 2005). The individual interviews and focus group were audio-recorded for accuracy. According to Merriam and Simpson (1995), electronic interviews are the preferred approach to collect interview information.

**Participant resumes and curriculum vitae.**

As an approach to collect preliminary information on the participants to be interviewed in the study, the researcher requested resumes or curriculum vitae from each participant prior to their interviews and focus group in order to gather basic demographic information on the population. The resumes and curriculum vitae validate the participants’ participation in the study to include adhering the criteria set forth in the research study.
In-depth Interviews.

According to Yin (2014), “The nature of the interview is much more open-ended and an interviewee many not necessarily cooperate in sticking to your line of questions” (p. 88). According to Merriam and Simpson (1995), the interview is an information gathering technique that “adds a dimension to the data gathering” that other approaches lack (p. 150). This qualitative research study was inherently designed to understand student success in developmental mathematics courses from the perspective of the developmental mathematics instructor. Interviewing is a fairly common method used by researchers to collect qualitative data (Merriam, 1988), and case study research relies heavily on this process of data collection. Conducting in-depth interviews with developmental mathematics instructors within the North Carolina Community College System (NCCCS) provides a way to understand student success by investigating the experiences, perceptions, ideologies, and beliefs of developmental mathematics instructors. Face-to-face interviews entail the researcher talking to individual participants. According to Yin (2014), “The nature of the interview is much more open-ended and an interviewee many not necessarily cooperate in sticking to your line of questions” (p. 88). This research incorporates the use of a semi-structured interview to ensure consistency from one interview to the next and allows participants to share their individual and in-depth perspectives on the protocol questions [Appendix C]. Individual, face-to-face interviews were conducted with participants who volunteer to participate in the research study. A focus group of developmental mathematics instructors was conducted subsequent to the individual interviews. Individual participants, along with other developmental mathematics instructors, were invited to participate in the focus group using a participation flyer that was circulated electronically. The order of the
individual interviews and the focus group is based solely on the researcher’s preference. Resumes and curriculum vitae were requested from the participants to assess their match for the research study and to assess each developmental instructor’s background, education, and training. The face-to-face interviews focused on establishing each participant’s perception of developmental education, developmental mathematics, and instructional strategies that each uses to support student success. A copy of the interview guide was provided. All interviews were digitally recorded to ensure accuracy and correct transcription. During the individual interviews, a semi-structured interview approach was utilized to allow instructors to articulate their views based on the protocol questions.

Focus groups

The focus group requires the researcher to “recruit and convene a small group of persons” (Yin, 2014, p. 112). The focus group is another qualitative method that will be used to collect information from developmental mathematics faculty regarding their pedagogical practices, classroom environments, students, beliefs, and perceptions about developmental mathematics as a discipline and about the students who enroll in developmental mathematics. The use of a small focus group allows and encourages developmental mathematics instructors to revisit their experiences as educators and simultaneously build on the experiences of other instructors. According to Marshall and Rossman (2006), focus groups are “socially oriented, studying participants in an atmosphere more natural” than the one-to-one interview (p. 114). The focus group interview was digitally recorded to allow the researcher to review the dialogue and responses during the analysis phase of the research study to help with coding and identifying emerging themes.
**Document Review**

Yin (2014) indicates that the review of documents is used to substantiate and corroborate various sources of evidence. To provide a definitive comparison among developmental mathematics instructors who participate in the study, departmental syllabi, course assignments, and assessments in developmental mathematics courses will be reviewed to correlate instructors into categories based on their responses to research questions regarding pedagogical practices, classroom environment, and their beliefs and perceptions. The review of documents “should be linked to the research questions” posed in the research study (Marshall & Rossman, 2006, p. 108). The documents in review from the instructors who will participate in this study will allow for an objective response to the research question that seeks to ascertain the similarities and differences among developmental mathematics instructors who self-report as having high success rates in their developmental mathematics courses.

**Data Analysis**

Unlike quantitative research, qualitative research is not linear or step-by-step (Marshall & Rossman, 2006). In case study research, the researcher serves as the primary instrument of data collection and analysis (Marshall & Rossman, 2006; Merriam, 1988; Maxwell, 2005). In order to assign meaning to qualitative data, analysis on the data must be completed. According to Merriam (1988), “Collection and analysis should be a simultaneous process in qualitative research” (p. 123). Therefore, during the continuum of this research study, new insights were developed as the researcher poses questions and receives either confirmatory or new ideas on the research topic, which render it recursive and dynamic.
In accordance with established criteria, eight developmental mathematics instructors were invited to participate in a face-to-face interview on a volunteer basis. Developmental mathematics instructors were also invited to participate in a focus group. Participants in the focus group may or may not be the same participants who participated in the individual interviews. Due to nature of the selection process, the number of developmental mathematics instructors that possess either a mathematics (education) or mathematics (non-education) credential, the exact number of each participant type cannot be determined beforehand. Participants in the focus group will collectively provide information in an effort to better understand the challenges that confront the success of developmental mathematics students from the instructor’s vantage point.

Responses from developmental mathematics instructors were analyzed based on the academic credential they hold in mathematics or mathematics education. A table detailing the participants and their academic credential, along with an assigned pseudonym (fictitious name) will be used to show how the information will be cataloged.

Semi-structured interview questions will address the research questions posed in the research study. At the conclusion of the focus group and the individual interviews, Atlas.ti 8.1.0, a quantitative software program, was used to aid in the analysis and management of the data in the case study. The computer assisted software program was also used to “code and categorize large amounts of data” (Yin, 2014, p. 134).

According to Emerson, Fretz, and Shaw (1995), a first step in qualitative analysis is to thoroughly read the interview transcripts that are to be analyzed. After becoming exceedingly familiar with the interview transcripts through listening and transcribing the interviews, a computer-assisted qualitative program analysis will be used to identify
categories, sub-categories, themes, and metaphors as a means to delve into the experiences of research participants. During the review of the recorded interviews, the researcher should take notes to help identify possible categories and themes included in the data responses.

After the completion of the aforementioned steps, the researcher will continue to immerse himself in the recorded transcripts of the focus group and the individual interviews in an effort to establish and recognize emergent themes within the data. According to Yin (2014), five strategies exist for the analysis of case studies: pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis. Detailed explanations follow regarding the specific strategies that will be employed for data analysis.

**Cross-case synthesis**

Cross-case synthesis, as a case study analysis technique, allows the researcher to intensify his understanding of the variables that ultimately impact student success in the developmental mathematics class. Cross-case synthesis allows for the analysis of multiple cases (Yin, 2014). The cross-case synthesis process allows for the display of data from individual cases in accordance with multiple categories. This research study will examine data collected that categorizes the academic credentials of mathematics instructors and other relevant themes that will emerge from the data.

**Coding**

Coding is essentially a process of organizing and sorting data, and it is the main categorizing strategy used in qualitative research (Maxwell, 2005; Schwandt, 2007). The overall goal of coding is to arrange data into categories that allows for comparison of concepts in the same category. According to Maxwell (2005), categorizing analysis entails “organizational, substantive and theoretical” categories (p. 97). The researcher will establish
organizational categories prior to the onset of research whereas substantive and theoretical categories will emerge after immersion into the data from transcript reviews. Marshall and Rossman (2006) indicate that once the researcher has assimilated categories and themes based on the data, codes are used to align with established themes and categories. Atlas.ti 8.1.0 will aid in the assignment of specific codes based on themes and categories.

The researcher proposed to analyze the results from the protocol questions to respond to the research questions, determine themes, myths, categories, and subcategories that connect student success with the instructional and pedagogical strategies utilized by developmental mathematics instructors at the research institution.

**Ensuring Reliability and Validity**

Concerns relating to reliability and validity are major tenets of qualitative case study research (Marshall & Rossman, 2006; Maxwell, 2005; Merriam, 1988). This research study will employ three techniques to ensure validity: intensive, long-term involvement, triangulation, and member examination. The research study employed three techniques to ensure reliability: triangulation, audit trails, and rich, thick description.

**Validity.**

According to Merriam (1988), validity has to do with how closely the findings in a research study match reality. Maxwell (2005) indicates that validity is indicative of “credibility of a description, conclusion, explanation, interpretation” of research findings (p. 106). According to Merriam (1988), an assumption of qualitative research is that reality is “holistic, multidimensional, and ever-changing; it is not a single, fixed, objective phenomenon” (p.167). As a result of reality being viewed this way, internal validity is deemed a strength.
**Intensive, Long-term Involvement.**

According to Goetz and LeCompte (1984), extended periods of time with research participants allows the researcher to continually collect and analyze data. Long-term observations or engagement with research participants allows for continuous data gathering in their natural environment and increases the validity of the findings (Maxwell, 2005; Merriam, 1988). During the research study, the researcher conducted in-depth interviews with the research participants in a semi-structured interview. The interviews were conducted at the institution where the participant is employed in order to gain a sense of the environment in which the participant works.

**Triangulation.**

Triangulation is the collecting of information for multiple settings, using various methods (Maxwell, 2005; Merriam, 1988; Yin, 2014). Triangulation reduces the risks of internal biases or “chance associations” (Maxwell, 2005, p. 112). The use of multiple sources of data allows the researcher to develop a convergence of evidence that support the validity of the research study. This research project utilized individual, face-to-face interviews, focus groups of developmental mathematics instructors, and document review to arrive at conclusions to the research questions. The triangulation of the data collection techniques will further support the validity of the research study.

**Member examination.**

Maxwell (2005) refers to peer examination as respondent validation, which entails verifying the themes and conclusions from the persons involved in the research study to assess the findings with their reality. Allowing for peer examination of the data does mitigate the possibility of sheer misinterpretation of statements given by research
participants. Merriam (1988) indicates that validity in case study research can be supported by peer examination. Member examination involves participants reviewing portions of the data to assess if the findings are congruent with their experiences as developmental mathematics instructors.

**Reliability.**

According to Merriam (1988), reliability in a research study is the degree to which the research study can be replicated by other research or under similar conditions. The research study will employ three techniques to ensure reliability: triangulation, audit trails, and a rich, thick description.

**Triangulation.**

Triangulation is the collecting of information for multiple settings, using various methods (Maxwell, 2005; Merriam, 1988; Yin, 2014). Triangulation reduces the risks of internal biases or “chance associations” (Maxwell, 2005, p. 112). The use of multiple sources of data allows the researcher to develop a convergence of evidence that support the validity of the research study. This research project utilized individual, face-to-face interviews, focus groups of developmental mathematics instructors, and document review to arrive at conclusions to the research questions. The triangulation of the data collection techniques further support the reliability of the research study.

**Audit trails.**

Audit trails are useful methods for ensuring reliability in case study research (Merriam, 1988). Audit trails “describe in detail how data were collected, how categories derived, and how decision were made throughout the inquiry” (Merriam, 1988, p. 172). The audit trail in this study includes participant resumes and curriculum vitae, audio recordings,
transcripts of interviews, and field notes. The audit trail describes how data were collected, how categories are derived, and overall decisions.

**Rich, thick description.**

According to Maxwell (2005), intensive interviews allow the researcher to collect rich and meaningful data in order to get a full picture of what is occurring in the study. Rich descriptions require intense interaction in an effort to express the experiences of the research participants. The researcher immersed himself in a review of the recorded interviews and focus group responses in efforts to establish themes, connections, and conclusions.

**Issues of Trustworthiness**

Specific strategies were in place to ensure the integrity of the research process and findings. During the collection of data, data was continuously analyzed. According to Maxwell (2005), “Reading and thinking about your interview transcripts and observation notes, writing memos, developing coding categories and applying these to your data, and analyzing narrative structure and contextual relationship are all important types of data analyses” (p. 96).

In addition to reviewing recording transcripts, memo notes, and working to develop coding categories, the researcher worked to verify the accuracy of notes and interpretations of interview transcriptions with research participants. The methods used to verify both validity and reliability in the study were used to further promote the issue of trustworthiness of the research study, data collection, and conclusions.

Data was collected and stored in a locked cabinet in a home office. Electronic files and audio recordings were saved to a personal computer which is both password and fingerprint protected. Backup files of electronic documents will be stored using an external
hard drive. All research materials will be disposed of after the designated time as determined by the IRB. Participant confidentiality and anonymity will be maintained by the use of a pseudonym for each research participant. A list with the actual names of the research participants will be stored in a locked cabinet in a home office and on a personal computer which is both password and fingerprint protected.

In addition to the aforementioned steps, triangulation of data collection as demonstrated by individual interviews, focus groups, and document review, along with an opportunity for participants to review their transcripts and provide feedback to the researcher will further support efforts to ensure the trustworthiness of the data.

**Researcher Subjectivities**

In case study research, the researcher serves as the primary instrument of data collection and analysis (Marshall & Rossman, 2006; Maxwell, 2005; Merriam, 1988). As a result of the researcher being the primary instrument of data collection, it is imperative to address the implicit biases and assumptions held by the researcher.

Having an idea of what the research study may inherently reveal – that developmental mathematics educators who possess a mathematics education credential have a greater impact on the success of developmental mathematics students because of their knowledge base in pedagogy will help to structure data and collection so as not to simply confirm the expectations.

Based on the researcher’s experience as a developmental mathematics instructor, his personal tendency to prefer female mathematics instructors to male instructors is a bias lens that will be addressed in the study. The idea that female instructors are more nurturing and supportive than their male counterparts is another bias that must be consider as interviews are
conducted with individual developmental mathematics instructors. On the basis of the bias, he will have to ensure that he works to select a representative sample of developmental mathematics instructors that equitably represents both genders.

**Summary**

Using a qualitative case study as the methodology to gain an in-depth understanding of the research topic, chapter three outlined the research approach, research design, data collection methods, and data analysis involved in this research study. Additionally, components were integrated throughout the chapter to address issues related to the reliability and validity of the design, researcher subjectivities, and issues of trustworthiness.
CHAPTER FOUR: CASE OVERVIEW AND ANALYSIS

The purpose of this research study was to explore the impact that faculty credentials of developmental mathematics instructors have on the success of developmental mathematics students within a community college. The intention of this study is to understand the similarities and differences in the pedagogical and instructional practices, classroom settings, and educational ideologies of developmental mathematics instructors with a degree in mathematics education as compared to developmental mathematics instructors with a degree in mathematics (non-education). Participants in this research study volunteered to participate in the study and adhered to the established criteria:

- Education: the participant possesses either an undergraduate or graduate degree in mathematics or mathematics education
- 2015 Performance Measure: the participant institution had 2015 subsequent math performance scores higher than the North Carolina Community College system average
- Position: participant currently teaches developmental mathematics at a North Carolina Community College.

The individual, in-depth interviews and focus group took place on the campus of Largo Community College (a pseudonym) in the fall of 2017. The individual interviews and focus group conducted in this research study gave first-hand accounts by those with “boots on the ground” every day in the developmental mathematics classrooms at Largo Community College. The responses from the individual interviews and the focus group expressed candid accounts of what is working well in developmental mathematics, existing issues with
developmental mathematics, and insights into proactive measures for the discipline looking forward.

Developmental mathematics continues to serve as a gatekeeper course for many students who enter postsecondary education that precludes many students from entering the required program or curriculum mathematics course, which consequently prevents many students from earning their college credential (Bonhan & Boylan, 2011). Community college faculty members are typically hired for their content expertise rather than their pedagogical or instructional expertise (Grubb, 1999); therefore, a gap in teaching ability and student learning needs may exist that creates barriers for many developmental mathematics students.

The research study was designed to collect input from current developmental mathematics instructors at a community college in order to answer the following research question and add to the existing body of knowledge regarding the impact that the credential of developmental mathematics faculty member has on student success in developmental mathematics:

RQ1: What are the pedagogical practices of developmental mathematics instructors who have either a mathematics education or mathematics (non-education) degree?

RQ2: How are the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree similar to developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ3: How are pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree
different than those utilized by developmental mathematics instructors who earned a mathematics (non-education) degree?

RQ4: How do the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who report high student pass rates differ from developmental mathematics instructors who do not have high pass rates?

This chapter presents an overview of how the research institution was chosen, a description of the developmental mathematics faculty at Largo Community College who participated in the study and their account of the pedagogical and instructional practices that they feel promote success in developmental mathematics, a summary of the coding process, responses to the research questions, emerging themes, and a chapter summary. All participant names, places, and institution have been replaced with pseudonyms to protect the confidentiality of each participant in this research study. Participants were given the opportunity to self-select their pseudonym that would be used to reference them throughout this research study.

**Identifying the Research Site for the Case Study**

After the approved IRB was received, the selection of an appropriate research site began. In accordance with established criteria, the participant institution was required to have scores in curriculum mathematics that exceeded the North Carolina system average in 2015, after the last developmental mathematics course. The researcher contacted the chief academic officers at five North Carolina community colleges to request permission to conduct the research study at their respective institution. Each institution was provided an overview of the research study, along with a form to conduct research. The first institution considered the request to conduct research in conjunction with its institutional review
process; however, the institution declined the request shortly after submission. The second institution granted permission to host the research study, but an investigation of the number of full-time and adjunct faculty revealed the institution did not have a sufficient number of developmental mathematics faculty for the research study. Institution three did not respond the request to conduct the research study. Institution four replied to the request to conduct the research study and indicated that the request would be forwarded to the president of the institution. No further follow-up was received from institution four. Institution five, hereafter referred to as Largo Community College (pseudonym), responded affirmatively to the request to conduct the research study and submitted a formal letter granting permission to researcher to conduct the study. Further review of Largo Community College revealed that a sufficient number of developmental mathematics faculty were employed at the institution to carry forth the research study. On the basis of its acceptance to allow the research study to be conducted and upon verification of a sufficient number of developmental mathematics faculty, Largo Community College was chosen as the research institution.

After the research institution was selected, collaborated efforts with the department chair to select participants for the individual interviews and the focus groups commenced. The department chair sent an email request to full-time (17) and adjunct (15) developmental mathematics instructors to participate as a volunteer in either the individual interview, the focus group, or both. The request also included an overview of the research study, along with a deadline to express interest in the study. A total of seven volunteers indicated their willingness to participate in the study. Subsequently, the researcher contacted each volunteer and began setting up a schedule of individual interviews and a focus group during the fall of 2017 on the campus of Largo Community College.
Case Study Setting

To maintain the anonymity of the research institution, the pseudonym, Largo Community College (LCC), was selected. Largo Community College is one of 58 community colleges within North Carolina Community College system. During the fall of 2017, Largo Community College employed 17 full-time developmental mathematics instructors and 15 adjunct developmental mathematics instructors. All of the developmental mathematics instructors at LCC were sent an email inviting them to volunteer to participate in the research study. The instructors were given a date by which to express their interest in participating in the study. The number of volunteer participants initially totaled eight. As the dates and locations of the individual interviews were being finalized, one of the participants indicated that he may not be able to participate in the study due to personal reasons. The researcher scheduled three days to be at the research location and during the three days, seven individual interviews of developmental mathematics instructors were conducted, along with a focus group consisting of five developmental mathematics instructors. The individual interviews were conducted in the office of the faculty member or in a private office at the institution. The focus group was conducted in a private office space.

Transcription and Coding Methodology

At the conclusion of the data collection process, the raw data results needed to be organized to so that the analysis can begin (Merriam, 1988). Organization of the raw data encompassed the transcription and coding processes to carefully identify categories, typologies, and theories that interpreted the data in conjunction with the proposed research question (Merriam, 1988). Each of the individual developmental mathematics instructors’ interviews and the focus group was digitally recorded to allow the researcher to be actively
engaged in the interview process and to also allow the researcher to critically review the individual and group responses in order to accurately transcribe the response at a later time. After leaving the research location, the digital interviews were partially transcribed using the software package Transcribe. After the digital recordings from each interview and the focus group were transcribed using Transcribe, the researcher carefully reviewed the transcribed output. The transcribed output consisted of raw data and contained no punctuation, unfamiliar terms were inserted by the software program in the place of unrecognizable words or sounds, and many words were omitted. In order to accurately align the transcribed output with the correct responses from the participants, the researcher listened to the audio recording for each participant and the focus group while simultaneously reading and editing the transcribed raw data output. During the review and edit process, correct punctuation, missing words and ideas were inserted, and inaccurate words were modified to accurately reflect the participant’s correct response.

Finalized interview transcripts were reviewed a second time for accuracy. Even with software available, the editing and review process of transcription was very tedious and time-consuming. Once the final interview transcripts were completed, the transcript of each participant was shared electronically with each participant to verify its accuracy and context. The research participants were instructed to read their transcript and if any portion of the transcript was inaccurate, they were directed to make the necessary corrections and resubmit the transcript to the researcher. Only one participant edited and resubmitted their transcript. Participants who did not resubmit their transcript were in agreement to its accuracy. After final reviews of each transcript by and upon verification from each research participant, the coding process began.
Coding is the process of organizing and sorting data, and it is the main categorizing strategy used in qualitative research (Maxwell, 2005; Schwandt, 2007). The overall goal of coding is to arrange raw data into categories that allows for comparison of concepts in the same category. According to Maxwell (2005), categorizing analysis entails “organizational, substantive, and theoretical” categories (p. 97). Prior to the coding process, the researcher established organizational categories to ensure that substantive and theoretical categories would emerge after immersion into the data from transcript reviews. Marshall and Rossman (2006) indicate that once the researcher has assimilated categories and themes based on the data, codes are used to align with established themes and categories. All interview transcripts were uploaded into Atlas.ti 8.1.0 to aid in the assignment of specific codes based on themes and categories.

The researcher analyzed the results from the protocol questions to respond to the research questions of the study, and to determine the themes, myths, categories, and subcategories that connect student success with the instructional strategies utilized by developmental mathematics instructors at a Largo Community College.

**Interview Participants**

Seven developmental mathematics faculty volunteered to participate in the individual interviews. Of the seven developmental mathematics instructors who participated in the individual interviews, five of them also agreed to volunteer to participate in the focus group session. The developmental mathematics instructors who participated in the study represented a variety of educational backgrounds, experiences, employment statuses, and years of service in developmental mathematics education. See Table 1 for a summary of the research participants.
Table 1

Interview and Focus Group Participants

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>FT/Adjunct</th>
<th>Focus Group</th>
<th>UM</th>
<th>UME</th>
<th>GM</th>
<th>GME</th>
<th>Years Teaching (total)</th>
<th>Years teaching developmental math (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benjamin Button</td>
<td>FT</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>11-15</td>
<td>6-10</td>
</tr>
<tr>
<td>Galois Marlboro</td>
<td>Adjunct</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>6-10</td>
<td>6-10</td>
</tr>
<tr>
<td>Meredith Grey</td>
<td>FT</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>0-5</td>
<td>0-5</td>
</tr>
<tr>
<td>Mrs. Funn</td>
<td>Adjunct</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>16-20</td>
<td>6-10</td>
</tr>
<tr>
<td>Professor</td>
<td>FT</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>30+</td>
<td>30+</td>
</tr>
<tr>
<td>Professor Anna</td>
<td>FT</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>30+</td>
<td>21-25</td>
</tr>
<tr>
<td>Sophia Germain</td>
<td>FT</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>6-10</td>
<td>6-10</td>
</tr>
</tbody>
</table>

Note. FT = full-time faculty. UM = undergraduate degree in mathematics; UME = undergraduate degree in mathematics education; GM = graduate degree in mathematics; GME = graduate degree in mathematics education.

Interview of Meredith Grey.

Meredith Grey holds both an undergraduate and graduate degree in pure mathematics and has been teaching developmental mathematics for five years at Largo Community College. She has no previous teaching experience outside the community college setting and has received her training on working with developmental mathematics students by being a developmental mathematics instructor at Largo. She believes that developmental mathematics students can be successful with the correct institutional policies in place that support instructional and pedagogical practices. She also believes that more accountability
and responsibility should rest with the developmental mathematics student. Each semester, Meredith purposely requests to teach developmental mathematics because she firmly believes that developmental mathematics is the foundation upon which curriculum mathematics courses are built and if the foundation is shaky, the entire mathematical learning structure is in jeopardy. She thoroughly enjoys making sure that students have a firm foundations upon which to build their mathematical learning.

**Pedagogical and Instructional Practices**

When asked about the instructional and pedagogical practices that positively impact student success in developmental mathematics, Meredith Grey stated:

So, this probably varies with the type of class. I have taught a face-to-face DMA 065 which is DMA 60, DMA 70 and DMA 80 where we lecture. In that class in particular, we do a lot of handouts for teaching things such as factoring which is really big moving forward in mathematics. Essentially, so lots of handouts, lots of group activities just to make sure that they are understanding it. We have lots of homework, so in class sometimes with the face-to-face class, we do a mini quiz on the homework that they were supposed to do the night before. It wasn't necessarily due, but to keep them on track and make sure they are doing the assignments and to give them some motivation to finish it when they should be finishing it. Now, for the ones that are taught primarily online, the students still come to class and work on a computer, but we aren't lecturing. So, in those classes, those are the ones where our success rates are not as high. For the hybrid classes, I keep a sheet of where everyone is every single week and I'll walk around to each of them individually and say, “Hey, this is where you were last week” and I will see where they are now and if they didn't do any work on the weekend, I will say, “You need to be working on this over the weekend”. So, it's more of a verbal kind of motivator there because there's not really anything with the way this class is setup to motivate them more than just having a quiz or something like that.

When asked about the instructional and pedagogical practices that negatively impact student success in developmental mathematics, Meredith Grey stated:

Well, I will say, with the way that we have it set up here at Largo and I don't know if this is across the board in North Carolina, but it's how we do it here. With the ones [courses] that are primarily online, I think the set up with not having any in-class assignments or lecture probably hurts them. I think that could be something that we could go off of there. I think that could push them back for sure because all of these
students are developmental. They’re in developmental math for a reason so they struggle with math, a lot of them struggle with technology. So, just working through the stuff through the website itself is hard for some of those students.

**Interview of Mrs. Funn.**

Mrs. Funn holds an undergraduate degree in mathematics education and spent approximately 15 years working as a high school mathematics teacher in both public and private schools. Additionally, she has worked as both a high school homeschool teacher and a tutor for over 32 years. She has been teaching developmental mathematics at Largo Community College for six years and thoroughly enjoys working with all students and helping students to move past the math hurdle.

**Pedagogical and Instructional Practices**

When asked about the instructional and pedagogical practices that positively impact student success in developmental mathematics, Mrs. Funn stated:

Considering the emporium model for developmental mathematics, one of the things that I do during class time is I walk around the class. So, I don't stay up front and wait for someone to ask for help. I actually monitor what the students are working on. I find they will ask questions more readily than if I'm standing at the front of the class. Number two, when they do ask for questions, if depending on the type of problem, I'll try to show them more than one way to approach the problem. Also, writing down steps helps, as well. So, I'll say, step one, if this is a situation, look for this, step 2, step 3 depending on the type of problem it is. So, I'll write this stuff down on their paper. So, those are some of the methods that I use in the classroom. I find the most effective is being able to show them more than one way to approach problem so that they could choose what best works for how their brain is thinking. Yes, making it very individualized for that student, letting him have the power of choosing which method he likes best. I do that for all my classes.

When asked about the instructional and pedagogical practices that negatively impact student success in developmental mathematics, Mrs. Funn stated:

Of course, group instruction (referring to modular format), you know doing instruction at the board because everybody's in a different position or a different place in their DMA. So, if I go to the board and do a general instruction, that's not going to help everybody in the class. So, it's least effective. Now, if I have a group of
students who are all in the same place and have the same question, and I'll bring them all up around the desk, but I don't find that happening very often in a class because they are at so many different levels. So, what happened is when I first started teaching here, I actually taught at the board because everybody in my classroom was in the same place, but now it has gone from a face-to-face course, which is a hybrid so they come to class, work on a computer, they work at their own pace and I'm basically monitoring, facilitating instructing on an individual basis depending on if they ask for help or not.

**Interview of Sophia Germain.**

Sophia Germain holds an undergraduate degree in mathematics and graduate degree in mathematics education. She has been teaching developmental mathematics at the community college for eight years. Prior to working in the community college, she worked in the retail industry as a human resources and operations manager and in that role, she trained “hundreds of people per year to their jobs.” However, she indicated that the position was not very rewarding, so she returned to school and began tutoring math in the college pre-calculus/trigonometry course and immediately fell in love with it. From that moment, she knew that she wanted to be a math teacher. She says, “I love teaching math more than I love math itself” and she loves when students change their minds from hating math to thinking “math is not that bad” or “I guess I can do math.” After earning her undergraduate degree in mathematics and realizing that she wanted to teach full-time in the community college, she decided to earn a degree in mathematics education. She says that the master’s degree in mathematics education has certainly equipped her with the skill set to better assist developmental mathematics students.

**Pedagogical and Instructional Practices**

When asked about the instructional and pedagogical practices that positively impact student success in developmental mathematics, Sophia Germain stated:
Well, there are several. I believe that assignments should demonstrate because I would like to understand how the student is looking at the problem, rather than just demonstrate how it should be done. And then, additional handouts and exercises because in developmental mathematics, there can be a need for even further remediation and so I have extra handouts and extra practice problems to give students on what we are working on.

When asked about the instructional and pedagogical practices that negatively impact student success in developmental mathematics, Sophia Germain stated:

I think a lot of online learning tends to lead to “monkey-see, monkey-do”. Students click on the help buttons like Help-Me-Solve-This, or Review-An-Example and what they end up doing is instead of learning the concept, they pattern seek and they apply patterns that they think they’re picking up in a View-An-Example problem and then applying it to the one they are trying to solve. It’s not mathematically sound, it only works half the time or less. So, I think that the View-An-Example in the online courses leaves students without an understanding of what they are doing mathematically and is pretty detrimental.

**Interview of Galois Marlboro.**

Galois Marlboro holds an undergraduate degree in mathematics (non-education) and has been teaching developmental mathematics for eight years. Prior to teaching at Largo Community College, he also taught developmental mathematics at the community college level at two other institutions. He firmly believes that public schools should be held more accountable as it relates to students not be college-ready in mathematics and he does not feel that developmental mathematics instructors who possess an educational credential are better suited to teach developmental mathematics, but feels that instructors with a pure mathematics credentials can more easily assess and correct students’ deficiency in mathematics.

**Pedagogical and Instructional Practices**

When asked about the instructional and pedagogical practices that positively impact student success in developmental mathematics, Galois Marlboro stated:

Well, one, I teach math by definition. In other words, I incorporate the language arts model to mathematics. Math is a language and the easiest way to access the languages
is to teach it by way of subject-verb agreement and grammatical constructs. I adopt that same framework and translate it to how I teach math. I work to get the students to understand and how to critically think about a question and answer the question that is asked of them.

When asked about the instructional and pedagogical practices that negatively impact student success in developmental mathematics, the Galois Marlboro stated:

The rote method of learning as it applies to the online modalities that we teach. I don't think they are very helpful because all that does is train the student to anticipate a question, play the question, learn how to answer, but not how to think so that later on, even though they've done well with homework assignments and when it's time to produce on an exam, they can't. That's a problem. It is the rote memory. It's the “what rules do I have to remember”? I discard the rules. I tell students there are a lot of rules you can learn, but you're memorizing them and you will forget them and if you don't learn the context, you'll be looking to apply rules in a different situation than it's designed for or you'll compare the rule to what you know based on your common sense and when it doesn't match, you won't know what to do. So, I let students know that they don't have to survive in math class and to eliminate the trial-and-error mechanism of figuring it out because that's what figuring it out means. So, if you give them something else to use other than that, meaning the literal definition then they're going to apply the definition and not be lost and think their way successfully through problems.

Interview of Professor.

The professor has been teaching at the community college for over 30 years in both Virginia and North Carolina. He holds both an undergraduate and graduate degree in mathematics education. During the early part of his career, he was a certified high school mathematics teacher. After earning his graduate degree in mathematics education, he began teaching at the community college, first as a developmental mathematics instructor and subsequently taught curriculum/college-transfer mathematics courses. Professor has also worked as a substitute teacher at the high school, along with working as an adjunct at a local 4-year institution. He is the principal author of a textbook about applied mathematics that was used widely within high schools and community colleges in Virginia. The professor
indicates that it was always his goal to teach mathematics at the high school level, but when
the community colleges needed developmental mathematics instructors, he found his niche.

*Pedagogical and Instructional Practices*

When asked about the instructional and pedagogical practices that positively impact
student success in developmental mathematics, Professor stated:

One thing that I always try to do, whether developmental or not, is to get the interest
of the student. I try to talk to students non-mathematically. For example, before a
class starts, I spend a few minutes just talking with students about anything other than
the course. One thing I tried to tell the students that each student in the classroom is
better at something than anybody else in this class. I just try to make students feel like
they are an individual, not just a math student because some of them feel that math is
not my thing, it’s not the favorite subject of many students. But also, one of the
slogans I have is “we’re going to have fun while learning”. Either we are going to
have fun while learning math or we’re going to have fun while learning statistics and
some students will admit, “I have had fun”. Many students will say that they hate
math and I say, “Well, you may never love math, but I hope you’ll get to the point
you don’t hate it”. I find that one way to do that is talk about an application problem.
If you can give him a problem that relates to something that they like to do or
something they are good at doing, then they can see the connection. For example, for
many years I taught math for the technical/vocational students and I could talk to the
automotive students about the gear ratio, your engine is turning so many RPMs, you
have a gear ratio in the transmission and you got a gear ratio in the rear end or the
front of the automobile, let’s figure out how the wheels are going. If you use a
certain diameter and let’s mark a spot on the tire and the engine has so many RPMs,
then how many revolutions do have on that tire? I mean that’s an application
problem, but it’s a terrific math problem using ratios and proportions right there.

When asked about the instructional and pedagogical practices that negatively impact
student success in developmental mathematics, the professor stated:

Probably one of the things that is least effective is just telling students here’s your
assignment, let’s do this. It goes back to this thing of getting the students’ confidence,
building their confidence, because most of the student in developmental mathematics
have little confidence for the subject matter. They have not been successful in it for
the most part or maybe they have been away from it a long time and don’t remember
it, that’s one of the things I found for a number of years. I was teaching older
students, particularly teaching a night class, that’s when you get your older students
and the students have been away from the math, not using it, they have just forgotten
it, but if you can get them to that point whether it be working with their checkbook or
figuring the gas mileage on their automobile, that’s finding something that they have
an interest in. If you are just saying we have to do these problems and here’s your assignment, you’re not relating it to anything that they see a need for.

**Interview of Professor Anna.**

Professor Anna has taught developmental mathematics for over 20 years at Largo Community College and holds an undergraduate degree in mathematics and a graduate degree in mathematics education. Prior to her career at the community college, she worked as a high school mathematics instructor for 10 years. She emphatically states that she has always known that her “place” in teaching mathematics was in adult learning at the community college. A 1998 graduate of the Kellogg Institute at Appalachian State University where her practicum focused on how learning styles in mathematics affects students and instructors in the community college, she implemented what she learned from the institute and continues to incorporate some of the knowledge learned at the Kellogg Institute, especially the learning styles component.

Professor Anna says that she thrives in the community college environment and really enjoys teaching developmental mathematics. She indicates that she embodies a gentle nature in the classroom which helps many students proactively address their math phobia and anxiety. Being a firm believer in addressing the learning style of the learning, she assesses students’ learning styles and plans most lessons around the learning styles of students.

Professor Anna says the reward for teaching developmental mathematics is seeing the light bulb in students’ minds come “on”.

**Pedagogical and Instructional Practices**

When asked about the instructional and pedagogical practices that positively impact student success in developmental mathematics, Professor Anna stated:
I'm somewhat traditional, but I like to work in a lot of different ways to get students to understand. My practicum for the Kellogg Institute was *Integrating Student Learning Styles in Development and Intermediate Algebra*. So, I studied learning styles extensively and I am always teaching with the thought as to what is this student's learning style. What I found in my research from that practicum was that the vast majority of just people, in general, are very visual in their learning. I try to bring in eye-catching photos and diagrams and things that really enhance the presentation, but then I did find that everybody has a secondary learning style that is quite prevalent and important to them and their types of learning and so that would be the auditory or kinesthetic. Auditory seem to be most to be the secondary learning style. Only a few were kinesthetic, but when you found them, you really had to address their learning. When I see a student in class who is very antsy and figgity, if they benefit from movement and so, if I am demonstrating just addition on the number line or something, I've been known to have a student come up in the front and just kind of walk the number line with me, but they are talking about positive and negative numbers. Things like that seem to help, but I usually pick the person who seems to be leaning toward the kinesthetic learning style. We have some classes, many classes, that are self-paced, so I mean we're there to help them certainly. But, very personally speaking, I'm kind of a dinosaur. I much prefer the one-on-one. I don't want to say teacher-centric, but just actual old-timey, kind of teaching. It's fine by me to have a hybrid of the computer taught lessons, not computer type, but I mean the computer assignments that they work on, but I think it's very good to have that in-class instruction. It doesn't have to be completely instructor dominated. There are different ways to do that, you can do group work, you can have them do projects, things like that, but something that really involves the students and the instructor rather than the students just sitting and staring at the computer and going straight to the homework before reading anything, trying to work a problem by reading it and figuring out what the problem saying based on their previous math instruction from wherever they got it. I think it's human nature, you want to get that assignment done, so you go to it. We don’t have any real stepping stones built in for them to get to that, to require that they get to that. Now, we have a lot of help built-in, yes, but it's all optional – voluntary and so many of them will go straight to the question, having never read about the topic at all, but thinking that they should know it and try to figure out the question from the answers and there are helps in the question, but that's in our self-paced classes. That's what I teach, it’s called DMA 050. It's graphs and equations basically graphs and equations of lines, and that is more traditionally taught, but we have the computer, even optional computer instruction, but I find it that's what I like.

When asked about the instructional and pedagogical practices that negatively impact student success in developmental mathematics, the Professor Anna stated:

One thing that students are not very good at all is studying for their tests. They don't know how to study. So, I am still quite traditional, and they don't do as well with completely traditional methods, so that's why a hybrid of the computer and the
traditional class, as we called a lecture, is more helpful to bring the computer in at that point, very helpful. But as I said, I'm always trying to find different ways to pull them in so that it goes beyond just that traditional instruction to where the most traditional would be just writing on a whiteboard now, writing notes on the board and expect them to take it all down. Well, they are not doing that anymore. We have more of an outline of the lesson that we go through. The example problems are there, we work it whether it’s on the overhead or on the board or whatever and they can fill in their paper as they go along. That seems to help. A lot of the instructors at Largo are doing that. So, the least effective I would probably say which would the traditional, authoritarian-type of instructor as the fount of all knowledge and student just sits there and takes it all in and they're supposed to be doing all of the note-taking. It's just that we've gotten so far away from that and that is a very ineffective approach. But as I also started off, the answer was their study skills are woeful and they don’t know how to study for a math test. I try to incorporate in my teaching some of those helpful ways that they can study, but they still come into a math test thinking they're prepared, but they're not.

Interview of Benjamin Button.

Benjamin Button taught mathematics in the public high schools for 10 years and is finishing year 5 in developmental mathematics at the community college. Benjamin Button started teaching at the community college as an adjunct instructor. The adjunct opportunity eventually led to a full-time position at Largo Community College. Benjamin left her teaching position in the public school because the “job was overwhelming”. The classrooms were overcrowded, the lack of support and materials, and additional administrative duties and responsibilities interfered with the focus on educating students, developing best practices, and building relationships with students.

Benjamin holds both an undergraduate and a graduate degree in mathematics education. She feels that developmental mathematics classes are necessary to help students who have less than ideal math skills outside of high school. She also indicates that developmental mathematics classes allow students to transition from the public school atmosphere to the community college atmosphere where more emphasis is placed on the students’ role in the his or her education and success. She feels overwhelmingly that
community colleges are a bridge that helps move students from academic deficiency to college-ready.

**Pedagogical and Instructional Practices**

When asked about the instructional and pedagogical practices that positively impact student success in developmental mathematics, Benjamin Button stated:

The main setup for developmental mathematics classes is all computer-based and the students come into the computer lab and they work independently on their assignments. Some of them are in different levels, working on different developmental mathematics (DMA) courses and I’ve never really felt like that was the best way for students to learn mathematics. I would walk around and monitor their progress and help them when they needed help. I felt like I was more of a record keeper than I was a teacher. I was more of a coach, not necessarily an instructor in the traditional sense where I’m teaching. I’ve never felt like just throwing students in front of the computer and saying, here, learn this math. It was really hard on students who have been out of school for more than 10 years and that really wasn’t very good for them. They really need someone to sit down with them and give them examples and talk about things in the real world and how to apply the math. I have a list of Powerpoints to go with the lessons and I post them online, so they have a type of notetaking guide. I don’t want students to just be mindlessly writing things down, trying to get everything down. I use a lot of diagrams, definitions of math terms to help students learn.

When asked about the instructional and pedagogical practices that negatively impact student success in developmental mathematics, the professor stated:

Well, just straight lecture all the time is obviously going to lose the interest of many students. I just have to say straight lecture. I think a lot of rigid, strict guidelines sometimes can be difficult with students who are trying to return to school while juggling many other responsibilities. I believe in having deadlines and things like that, but you have to have a kind of grey area where you can work with someone and bend the rules a little bit, as long as you can do that for everyone.

**Emergent Themes from Interviews and Focus Group**

After the audio files of the individual and focus group interviews were transcribed, Altas.ti 8.1.0 was used to code the transcripts and to arrive at categories from the raw data.

The development of categories and themes entails an investigation into recurring regularities
within the data (Merriam, 1988). Priori codes were developed in response to the research questions before the initial coding process began. A list of priori codes is listed in Appendix D. The initial coding process of the interview and focus group transcripts was done with the research questions as the basis of the coding process. The initial coding process resulted in 73 codes. The 73 codes are contained in Appendix D. Many of the initial codes were similar and therefore collapsed into a category that supports student success in developmental mathematics. Four categories or themes emerged from the 73 codes and the theme/categories that rose to the surface included: Pedagogy and Instruction, the Classroom Environment, Relationship Building, and the Developmental Mathematics Instructor. A model developed by the researcher that formulates the role of the developmental mathematics instructor as the conduit of student success based on pedagogy and instruction, classroom environment, and relationship building is shown in Figure 2.
Research Questions Responses

In the developmental mathematics classroom, numerous factors are tied to student success. This research study utilized a qualitative case study research design to investigate the impact of faculty credentials on student success in developmental mathematics at a community college to answer the following four research questions. The responses to the research questions resulted from the coding, sorting, categorizing, and synthesizing of the transcripts of both interview and focus group participants. Although the findings from this research study cannot be generalized to other populations of developmental mathematics instructors, the findings help to shed light on the challenges confronted by millions of students who are trying to advance through their developmental mathematics sequence.
enroll in the required curriculum level mathematics for the respective degree or diploma program, earn a college credential, and subsequently enter the workforce.

RQ1: What are the pedagogical practices of developmental mathematics instructors who have either a mathematics education or mathematics (non-education) degree?
Table 2

Research Question Response 1

<table>
<thead>
<tr>
<th>Pedagogical/Instructional Practices</th>
<th>Developmental Math Instructors with UM, UME, GM, GME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided Practice assignments</td>
<td>✓</td>
</tr>
<tr>
<td>Group Instruction</td>
<td>✓</td>
</tr>
<tr>
<td>Collaboration</td>
<td>✓</td>
</tr>
<tr>
<td>Individualized instruction</td>
<td>✓</td>
</tr>
<tr>
<td>Integrate Study Skills</td>
<td>✓</td>
</tr>
<tr>
<td>Formative Assessments</td>
<td>✓</td>
</tr>
<tr>
<td>Lecture</td>
<td>✓</td>
</tr>
<tr>
<td>Skill and drill</td>
<td>✓</td>
</tr>
<tr>
<td>Debate</td>
<td>✓</td>
</tr>
<tr>
<td>Project-based assignments</td>
<td>✓</td>
</tr>
<tr>
<td>Peer teaching</td>
<td>✓</td>
</tr>
<tr>
<td>Present lesson in several ways</td>
<td>✓</td>
</tr>
<tr>
<td>Learning styles approach</td>
<td>✓</td>
</tr>
<tr>
<td>Games</td>
<td>✓</td>
</tr>
<tr>
<td>Vocabulary/Reading</td>
<td>✓</td>
</tr>
<tr>
<td>Pre-printed notes</td>
<td>✓</td>
</tr>
<tr>
<td>Model “think out loud”</td>
<td>✓</td>
</tr>
<tr>
<td>Concept connections</td>
<td>✓</td>
</tr>
<tr>
<td>Contextualized assignments</td>
<td>✓</td>
</tr>
<tr>
<td>Student-made assignments</td>
<td>✓</td>
</tr>
<tr>
<td>Appropriate questioning</td>
<td>✓</td>
</tr>
<tr>
<td>Mnemonic devices</td>
<td>✓</td>
</tr>
<tr>
<td>Technology integration</td>
<td>✓</td>
</tr>
<tr>
<td>Graphic organizers</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 2 details the pedagogical and instructional practices utilized by developmental mathematics instructors who possess either an undergraduate or graduate degree in mathematics (education) or mathematics (non-education). A multiplicity of instructional strategies are utilized by the collective group of research participants. Although the list does not identify the respondent for a particular pedagogical or instructional strategy; however, it is important to note that many developmental mathematics instructors (non-education)
incorporate instructional strategies in their lesson that would typically be thought to be utilized by a mathematics.

RQ2: How are the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree similar to developmental mathematics instructors who earned a mathematics (non-education) degree?

Table 3
Research Question Response 2

<table>
<thead>
<tr>
<th>Pedagogical/Instructional Practices</th>
<th>Developmental Math Instructors with UM, UME, GM, GME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided Practice assignments</td>
<td>✓</td>
</tr>
<tr>
<td>Collaboration</td>
<td>✓</td>
</tr>
<tr>
<td>Individualized instruction</td>
<td>✓</td>
</tr>
<tr>
<td>Lecture</td>
<td>✓</td>
</tr>
<tr>
<td>Concept connections</td>
<td>✓</td>
</tr>
<tr>
<td>Contextualized assignments</td>
<td>✓</td>
</tr>
<tr>
<td>Mnemonic devices</td>
<td>✓</td>
</tr>
<tr>
<td>Regulated Use of Technology</td>
<td>✓</td>
</tr>
<tr>
<td>Homogenous Grouping of Students</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 3 delineates the pedagogical and instructional common practices utilized by developmental mathematics instructors who possess either an undergraduate or graduate degree in mathematics (education) or mathematics (non-education). Both developmental mathematics instructor types indicated that the developmental mathematics instructor is essentially responsible for creating a classroom environment that is conducive to developmental education by fostering a sense of calm and connectedness among developmental math students. The developmental mathematics instructor sets the tone that
makes students feel invited and comfortable and in an environment that is typically very uncomfortable and stressful for many developmental math students. The developmental mathematics instructor is also responsible for ensuring that the learning styles of the diverse students in the developmental mathematics classroom are addressed in the various math lessons that are presented.

Both developmental mathematics instructor types expressed that technology is an important and crucial part of the developmental mathematics instruction; however, an overreliance on the technology is detrimental to student learning because it fosters pattern seeking to find solutions without a full understanding of mathematical concepts and applications. At Largo Community College, no attendance policy governed the developmental mathematics classroom because of the class format of the developmental mathematics classes. The consensus from the participants clearly expressed a mandatory attendance policy for developmental mathematics classes because as the number of days instruction between one mathematical concept and another, the less likely developmental mathematics students are to be able to bridge the gap between their current understanding and the pace of the developmental mathematics classroom.

RQ3: How are pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree different than those utilized by developmental mathematics instructors who earned a mathematics (non-education) degree?
Table 4

Research Question Response 3

<table>
<thead>
<tr>
<th>Pedagogical/Instructional Practice</th>
<th>Mathematics (Education)</th>
<th>Mathematics (Non-Education)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Instruction</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Integrate Study Skills</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Formative Assessments</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Skill and drill</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Debate</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Project-based assignments</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Peer teaching</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Present lesson in several ways</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Learning styles approach</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Games</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Vocabulary/Reading</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Pre-printed notes</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Model “think out loud”</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Student-made assignments</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Appropriate questioning</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Graphic organizers</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 4 differentiates the pedagogical and instructional practices utilized by developmental mathematics instructors who possess either an undergraduate and/or graduate degree in mathematics (education) or mathematics (non-education). The number of instructional and pedagogical categories varied greatly among the participants in the study. Many of the pedagogical and instructional practices utilized by participants with the mathematics (education) credential were introduced as part of the education that the participants received as part of the educational training in mathematics education. Although the participants with the mathematics (non-education) did not specifically mention many of the pedagogical and instructional practices from the overall list from Table 1, as community colleges work to ensure that timely and relevant training is provided to developmental mathematics instructors, developmental mathematics students are certain to become the
benefactors of such strategies that are consistently used by the developmental mathematics classroom.

As it relates to the educational ideology of the instructors in the study, some of the developmental mathematics instructors (education) expressed the need to require that developmental mathematics students become more accountable and responsible for their own learning in mathematics and not expect every learning process to be delineated. Overwhelmingly, the instructors (education) mentioned that providing too much guidance may negatively impact students’ performance in curriculum level classes.

RQ4: How do the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who report high student pass rates differ from developmental mathematics instructors who do not have high pass rates?
Table 5

Research Question Response 4

<table>
<thead>
<tr>
<th>Pedagogical/Instructional Practice</th>
<th>SR High Student Pass Rates</th>
<th>SR Non-high Student Pass Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrate Study Skills</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Formative Assessments</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Skill and drill</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Debate</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Peer teaching</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Present lesson in several ways</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Learning styles approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Games</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Vocabulary/Reading</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Pre-printed notes</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Model “think out loud”</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Student-made assignments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriate questioning</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Mnemonic devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic organizers</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

*Note: SR = self-reporting*

Of the seven interview participants in the study, only one developmental mathematics instructor self-identified as having high student success rates in developmental mathematics. The self-identified instructor possessed a mathematics (non-education) credential. The remainder of the interview and focus group participants indicated that they felt that the success rates of their overall developmental mathematics classes did not exceeded the excellence level of 75.4%. Instructors indicated that although they may have had individual classes that exceeded the excellence level, collectively, the overall success rates were considered at or below the system average level.

**Summary**

Chapter four provides an in-depth look at the impact of faculty credentials on student success in developmental mathematics via a qualitative case study by looking through the
lens of seven developmental mathematics instructors at Largo Community College. The viewpoints of each instructor, along with a focus group of five developmental mathematics instructors, was captured via a semi-structured interview that was recorded and later transcribed and coded.

An ideological and educational overview of each developmental mathematics instructor was provided, along with their pedagogical and instructional highlights in order to shed light on the varied instructional practices of each on the basis of their varied educational backgrounds and experiences. Selected quoted material from individual transcripts was provided to express the views of each participant.

Finally, the formal research questions were addressed using the coded interview responses that were categorized and synthesized. Overarching themes and categories emerged from the coded interviews that were used to develop a developmental mathematics pathway success model.
CHAPTER FIVE: FINDINGS AND RECOMMENDATIONS

Introduction

The purpose of this qualitative case study was to investigate the impact of faculty credentials on student success in developmental mathematics at a community college by taking a closer look at the pedagogical and instructional strategies utilized by developmental mathematics who possess either a degree in mathematics (education) or mathematics (non-education). In addition to the pedagogical and instructional strategies used by developmental mathematics instructors, the research also incorporated the classroom environment and educational ideology into the success of students in developmental mathematics.

Following the overview of the study is a discussion of the major themes identified from the research study that are supported in the literature, along with best practices used by developmental mathematics instructors that positively impact student success. Finally, conclusions, implications, and recommendations for future research will be the final topics covered in chapter five.

Research Study Overview

The majority of students enroll in community college with the intention of earning a college certificate, diploma, or degree that will offer them access to better employment opportunities that pay a higher living wage (Bye, Pushkar, & Conway, 2007; Compton, Cox, & Laanan, 2006; Francois, 2014; Ross-Gordon, 2003). However, the number of college students who place into developmental mathematics far exceeds the number of students in other areas of developmental education and creates a major barrier that prevents many students from earning their college credential (Bellafante, 2014; Bonham & Boylan, 2011;
This research study utilized a qualitative case study methodology to address the research problem and the corresponding research questions. Seven individual developmental mathematics instructors and a focus group consisting of five developmental mathematics instructors participated in the research study which allowed for the findings presented herein (see Table 1 for list of participants). Open-ended interviews, focus interviews, and document reviews were used as the basis of the triangulation process which yielded the overall findings from the qualitative research (Yin, 2014). The open-ended interviews and focus interviews were digitally recorded, later transcribed, and subsequently coded using Atlas.ti 8.1.0. to arrive at the responses to the research questions, along with emergent themes that were used to arrive at a model of success in developmental mathematics, presented in Figure 2.

The four research questions revealed similarities and differences between the two classification types of developmental mathematics instructors in terms of pedagogical and instructional practices as well as classroom settings and educational ideology on the basis of the academic credential held by the instructor. Research question 1 revealed that collectively, the developmental mathematics instructors at Largo Community College were equipped with diverse pedagogical and instructional tools to support developmental mathematics students in the classroom (see Table 2). Along with the collection of pedagogical and instructional tools used by developmental mathematics instructors who possessed either a mathematics (education) or mathematics (non-education) credential, Table 3, Table 4, and Table 5 delineate the similarities and differences in pedagogical and instructional practices of the developmental mathematics. From the coded interviews
emerged four themes or categories that support the success of students in developmental mathematics. The four themes that emerged were the following: the developmental mathematics instructor, classroom environment, relationship building, and pedagogy and instruction. On the basis of the responses from the interview and focus group, the four themes were coalesced into a model that supports student success in mathematics, presented in Figure 2.

**Findings from the Literature**

The themes that emerged from the interviews and focus group are supported by writings in the literature that address developmental mathematics, the integration of study skills, class format for developmental mathematics, pedagogy and instructional practices, and relationship building.

**Developmental Mathematics**

College students who place into developmental mathematics face major roadblocks in advancing to college-level mathematics classes and consequently in attaining their higher education credentials. Although the overall success rate at Largo Community College exceeded the system average, the research participants indicated that developmental mathematics continues to receive a great deal of attention because developmental mathematics serves as a gateway to curriculum level courses which stand between many students and graduation. As expressed by Meredith Grey, developmental mathematics is a cornerstone that equips students with the necessary prerequisite math skills to ensure that they are successful in their curriculum math course which ultimately leads credential attainment:

I think it's a solid foundation that a lot of students need. I think the way that it's set up for the community colleges doesn't exactly promote student success sometimes, but I
think as a discipline, more students need it. We implemented that [multiple measures] and our success rates in our pre-calculus classes has gone down dramatically and I think it's because they really need that developmental math. So, I think as a discipline, I think it's good there. I think we need to change some things to hold them more accountable than we do right now and to get them ready for a more college setting, but I think it is really important and it is what a lot of these multiple measure students are lacking for sure.

The intention of developmental education is to provide underprepared students the opportunity to enhance their academic skills in order to be successful in college-level work (Bailey, Jeong, & Cho, 2008) and eventually graduate. However, developmental education students continue to graduate at a significantly lower percentage than non-developmental students (Achieving the Dream, 2009). These students’ attainment of a college credential is compromised by barriers that developmental education courses often create for the students that they are designed to help. Although developmental education has experienced nationwide reformation initiatives, additional efforts to foster student success and completion in developmental mathematics need to be implemented.

**Study Skills**

It is no surprise that many developmental education students lack study skills, time management, and organization skills that foster and promote success in college, particularly in mathematics coursework. Skills that promote student success in academia include listening, research, reading techniques, thinking and study skills, vocabulary development, notetaking, organization, time management, motivation and self-concept (Devine, 1987). Developmental education students simply do not possess good study skills which puts them more at a disadvantage than other students. According to Cukras (2006), to help college students develop skills in self-regulation, reading and study skills must be utilized to address the deficiencies. In addition to lacking mathematical content knowledge, developmental
mathematics students are essentially weak in study strategies (Mireles, Offer, Ward, & Dochen, 2011). Mireles et al. (2011) indicates that there exists a myriad of methods for equipping students with the skills they need in order to be successful in college-level courses and the two most common methods are Supplemental instruction (SI) and strategy integration, often referred to as study skills or study strategies. The research findings of Mireles et al. (2011) indicate a positive correlation by developmental mathematics students in terms of success and retention; however, students must be taught study skills that are inclusive of addressing anxiety, concentration, attitude, information processing, test-taking skills, time management, study aids, and assessment strategies. The aforementioned skills taught in isolation do not support the self-regulation model of student success, but should be taught in conjunction with another course so that the material is relevant and applicable to ensure that students can readily see the integration of the skills learned in the study skills (Wingate, 2006). Mireles et al (2011) state that as students acquire study skills, success rate should also improve. The acquisition of study skills will ultimately assist underprepared students to experience success in developmental mathematics that lead to college graduation.

When asked about one of the greatest challenges that confront developmental mathematics students in the 21st century community college, Professor Anna vehemently mentioned the lack of study skills:

One thing that they are not very good at all is studying for their tests. They don't know how to study. Their study skills are woeful and they don't know how to study for a math test. I try to incorporate study skills in my teaching to show some of those helpful ways that they can study, but they still come into a math test thinking they're prepared, but they are not.

According to Gregory (2001), general study skills texts are readily available; however, few of them have skills specific to studying mathematics, how to read mathematics,
or take notes in a mathematics courses. Student success is a multi-dimensional term that encompasses graduate rates, retention, student satisfaction with an institution and its programs, minimum grade point averages (GPA), and passing prerequisite and curriculum courses. Typically, developmental math student are not self-regulated learners; therefore, they may quickly advance to a state of academic jeopardy due to the expectations of college and their inability to set, assess, and advance toward specific goals.

**Pedagogy**

The importance of pedagogy and its connection to student success cannot be overstated. Pedagogy and instructional practices and approaches were the tenets of the research questions in this study and it is not surprising that pedagogy and instruction rank high as a pillar of student success in developmental mathematics. Research from various sources corroborate one of the major findings in this research study.

If educational programs are to be successful, they must incorporate multiple teaching and learning strategies because learners are unique and differ in the learning styles (Bonham & Boylan, 2011). Bonham and Boylan (2011) expressed the inherent component in any course redesign to incorporate the use of diverse teaching strategies rather than a single method to promote success in developmental mathematics. Research-based strategies include, but are not limited to, mastery learning, active learning, individualized assistance, modularized instruction, use of technology, and collaborative methods.

According to Hiltz (1998), collaborative learning or active learning refers to instructional approaches that entails students working together on academic tasks. Collaborative learning is essentially different than pure lecture as the standard medium of sharing information and knowledge; however, collaborative leaning is a facilitative approach
that allows the instructor to promote active learning and engagement and students filter new knowledge through their contextual experiences that makes the learning more impactful and relevant. Student who are engaged in active-learning environments, per the findings of McCarthy and Anderson (2000), indicate that the satisfaction level of students who are actively engaged in classes is significantly higher than students in traditional lecture classes, which ultimately leads to higher graduation numbers.

When asked about the instructional strategies that support student success in developmental mathematics, interview and focus group participants expressed the need to diversify instruction based on the different learners that are in the class. Professor Anna stated the importance of integrating learning styles and effective instructional practices in the developmental mathematics classroom:

I'm somewhat traditional, but I like to work in a lot of different ways to get them to understand. I am always teaching with a thought as to what is this student's learning style and what I found in my research for that practicum was that the vast majority of just people in general are very visual in their learning. I try to bring in, eye-catching photos and diagrams and things that really enhance the presentation. When I see a student in class who is very antsy and figgity, if they benefit from movement and if I am demonstrating addition on the number line or something, I've been known to have a student come up in the front and just kind of walk the number line with me, but they are talking about positive and negative numbers. Things like that seem to help, but I usually pick the person who seems to be leaning toward the kinesthetic learning style. Like I said, we have some classes, many classes, that are self-paced, so I mean we're there to help them certainly. But, very personally speaking, I'm kind of a dinosaur. I much prefer the one-on-one, I don't want to say teacher-centric, but just actual old-timey, kind of teaching. It's fine by me to have a hybrid of the computer taught lessons, but I mean the computer assignments that they work on, but I think it's very good to have that in-class instruction. It doesn't have to be completely instructor dominated. There are different ways to do that, you can do group work, you can have them do projects, things like that, so but something that really involves the students and the instructor rather than the students just sitting and staring at the computer and going straight to the homework before reading anything, trying to work a problem by reading it and figuring out what the problem saying based on their previous math instruction from wherever they got it.
**Relationship Building**

The human connection that exists between the developmental mathematics instructor and the developmental mathematics students is an important relationship that fosters success in the developmental mathematics classroom. According to Galbraith and Jones (2006), teaching is a multi-faceted phenomenon that must incorporate the heart and soul of the teacher and student if learning is to be effective and meaningful, especially for developmental education students. McCarthy and Anderson (2000) go onto say that human interaction is at the “heart” of learning and education, yet most educators at the postsecondary level expect student to acquire the necessary skills with little, if any, interaction with their classmates or facilitator.

Research participants echoed similar expressions that communicated the importance of the establishing and maintaining proactive, student-focused relationships in the developmental mathematics classroom. Participant Mrs. Funn eloquently expressed the importance of establishing a positive interaction with developmental math students to promote student success:

I try to greet every student who comes into the classroom, welcoming them, either in the morning or in the afternoon, and I try to do that by name. It usually takes me two class to learn all the names. I have a positive attitude. I smile. I don't get frustrated with the student even if I've had to explain the same problem more than once or twice or three times. If that happens, you know how I'm presenting is a problem. I try to think of another way to present the problem. So, going back to changing up your teaching, if I find that I'm going to the student several times for the same kind of question, then I go, “Wait a minute. They are not getting it the way I'm presenting it.” Let's change the approach and try something different. I want them to be successful. That is my job. When they pass their test, I give them a thumbs up, I go, “Great job” or something like that so I want them to be successful. So, my attitude has to be like a cheerleader for them.

Professor shared the following comments about the importance of connecting with students on a personal level:
The biggest thing I think again was trying to relate to the student as an individual, not as a math student, but as an individual and that might be even talking about whatever they want to talk about. Sometimes I would tell students, what do you want to talk about today, not about math? I mean we would not spend the entire class period, but we could spend 3 minutes, 5 minutes or whatever. What do you want to talk about and sometimes it might be a sports activity, either going on at school or on television or it might be a comedy show or it might be mostly anything. I was hoping to talk about pretty well anything they wanted to as long as it was something suitable to talk about. We didn’t get into some topics. Yeah, but I think showing the student that you were interested in them as a person, that is strong evidence. You are gaining that student confidence and they are seeing you as an individual as opposed to a math instructor. Like I said earlier, I was trained to be a high school math teacher, took psychology and all these educational courses, it’s just my human nature. I’m not the brightest kid on the block, but I feel that I can do the job teaching.

Students fail to enroll in curriculum-level mathematics courses for a myriad of reasons related to developmental mathematics, including high rates of failure and non-completion, absence of content relevance, minimal support from colleges, faculty who lack interest in teaching developmental mathematics, and faculty who fail to understand the plight of the developmental mathematics student (Sierpinska, Bobos, & Knipping, 2008).

**Classroom Environment**

The theory of involvement posits that for learning and growth to occur, students must be actively involved in the learning environment. However, the mathematics classroom can be an intimidating place for many students; therefore, getting students actively engaged in the classroom and in the learning process rests with the developmental mathematics instructor. Milem and Berger (1997) explained that involvement is a crucial component of student persistence. In the absence of persistence, it is impossible for students to earn the college credential that initially brought them to the college.

In the developmental mathematics classroom, students must be involved in the learning process to realize the relationship between student persistence and student success. Students must understand that student persistence is a prerequisite for student success in
developmental mathematics. The theory of involvement also postulates that student learning is proportional to both the quality and quantity of the student’s involvement in the classroom environment.

The findings from this study further support the ideas expressed in the literature about student involvement in the classroom environment by stressing the importance of class attendance at an institution that does not mandate attendance in developmental mathematics classes, along with minimizing stress in the classroom. When asked about what developmental math instructors can do to promote success in developmental mathematics, Meredith Grey stated:

I think to have an attendance policy in developmental math classes if their institution allows for that. This is something that we are definitely going to implement in the spring because we've had so many attendance issues. So, just that alone just to get the students coming, especially for those where the classes are primarily online, that's a big thing because there is a lot of class time. If they are present and actually do the work, they can pretty much finish the earlier DMAs. They should have no problem, but it's just that they don't come. So, having an attendance policy in place and enforcing that would definitely promote student success.

To minimize stress that is often part of the developmental mathematics classroom, Benjamin Button expressed the following:

I think, for a lot of students in developmental math, they have this natural sort of fear of math or there's already kind of a barrier there that they bring in with them because generally the developmental math students are not the strongest math students. And especially if somebody hasn't had math in 15-20 years. So, I think to answer this question, I think there's already a stress level on the student when they are entering to begin with. So, rather than creating stress, the goal is to relieve some of that stress and ease students into what they're doing and building their confidence. Of course, testing is always the stress, we have to have a test and that's always the biggest fear and I think focusing on grades is really kind of a stressful thing for student. A single score, that’s stressful for them. To pass a test, a student has to make 80%, so it's like focusing on that number that makes it stressful for the students and not focusing how much have you learned. I encourage them to look at their progress, not just the final grade.
Technology

Technology is not the panacea for all of the ills and challenges that are part of developmental mathematics at the community college. Whereas technology is supposed to supplement pedagogical and instructional practices, an overreliance on it creates more damaging effects than benefits. As the number of students who place into developmental mathematics has increased over the years and to help defray institutional cost, research from Pretlow and Wathlington (2011) revealed that developmental education programs increased the number of developmental courses that were offered using technological approaches.

Monitoring the success of students in developmental mathematics is imperative as the use of course formats that integrate technology as a primarily means to convey developmental mathematics content. Research by Zavaarella and Ignash (2009) suggest that the effectiveness of computer-based instruction is lower than in traditional, face-to-face courses. The evidence indicates that students enrolled in computer-based classes have a much higher dropout rate than in traditional, face-to-face courses and therefore harms the bottom line of getting students through the developmental mathematics sequence.

Largo Community College utilizes an emporium delivery model for many of their developmental mathematics classes. Here is what Professor had to say about the online delivery method at Largo:

I don't have all of the numbers, but at Largo Community College, we teach developmental math in essentially three formats. We have strictly face-to-face, that’s our DMA classes, it is web-enhanced meaning that they do have software available. We have hybrid courses where part of the classes is lecture, part of it, they do outside and then we have strictly online classes where maybe they only face-to-face portion would be a proctored exam. Statistics tell us here, at this college, that the online portion is not as successful as either of the other two formats. And the hybrid is less successful than face-to-face. Because face-to-face, we have them in class, the whole time, as opposed to part of it, they're doing it on their own, outside of class. And many students I talk with feel they need that face-to-face.
Sophia Germain indicated that the reliance the technology has created additional problems with student learning:

Technology is amazing. Technology is really great. It's a great way of demonstrating things for students and technology is going to be something they have access to going forward, so they should know how to use it to their advantage when learning math. But I think the downside of it is also that you can't graph something by hand online, you have to click a graph online, so then, if you're tested on how to graph by hand, you've actually barely ever practiced that. So, I just think that there's something to being assessed in the same environment that you studied in. They always say if you drink coffee when you're studying, you should drink coffee when you're taking your test and if you usually work in pencil, you should work in pencil on your test. Well, if you usually do your homework online and you click everything into place with a mouse and then you take a test in class and it's on paper, in front of you, that's different and that's a problem. And I think the other thing is the way we're running our developmental math courses is completely different from our curriculum courses. I think our developmental math courses need to prepare them for other courses. Right now, with this flipped classroom, it's kind of like a study hall in a sense, you know they work at their own pace on the computer, they don't need to take notes, they don't need to write out problems, they can if they want to, but it's sort of an individual student-based decision. There isn't a lecture, so they're not practicing taking notes, studying those notes, studying for an exam. All of that has been taken out of developmental mathematics and then they take a curriculum course and that's actually the first time that it applies to their GPA. It is also the first time that there now trying to take notes and trying to study their own notes and read their own writing and take an in-class test

Conclusions

The researcher has drawn four main conclusions based on the research findings and the ideas that emerged during the face-to-face interviews, focus group, and data analysis. The conclusions drawn by the researcher fall into the following four categories that serve as cornerstones of success in the developmental mathematics classroom: pedagogy and instruction, class format, relationship building, and the developmental mathematics instructor.
Conclusion One: Pedagogy and Instruction

The researcher concludes that the success of developmental mathematics students is predicated on the students’ exposure to pedagogical and instructional practices that are diverse, research-based, and complementary to their individualized learning style as unique math learners. With an understanding that not all developmental mathematics instructors enter the profession with the necessary skill set to effectively provide diverse pedagogical and instructional strategies, it would be incumbent upon institutional leadership to ensure instructors who do not possess an education background or credential are paired with an experienced mentor to help provide guidance and direction on effective practices to use in the developmental mathematics classroom. Additionally, providing mandatory trainings periodically, regardless of academic credential, to equip new developmental mathematics instructors with best practices for teaching developmental mathematics and working with developmental mathematics students should be fostered to ensure that developmental mathematics students are receiving instruction that is grounded in research and best practices.

Pedagogy and instruction encompasses both study skills and learning styles. Because developmental mathematics students typically lack student success and study skills, ongoing efforts should be made to ensure that developmental mathematics students enroll in a study skills course upon entry into the college. The study skills course should introduce students to effective notetaking, how to study for tests, time management, and organization skills, along with a component that addresses specific success strategies that can be used in the developmental mathematics to foster success in the discipline.
Conclusion Two: Class Format

The researcher concludes on the basis of research and participant responses that the class format of developmental mathematics classes is paramount to their overall success. Many institutions have unintentionally jeopardized student success in developmental mathematics by allowing developmental mathematics students who lack self-regulation and appropriate study skills to enroll in online developmental mathematics wherein the majority of developmental mathematics students have been unsuccessful. On the basis of research, along with the view of the research participants, purely online developmental mathematics courses should not be offered to developmental mathematics students; however, a hybrid approach would be acceptable as it does allow students to have periodic, face-to-face interactions with their instructors and to receive feedback and guidance.

Conclusion Three: Relationship Building

The researcher concludes that the developmental mathematics classroom is a very stressful environment for the majority of developmental mathematics students. On the basis of the research and lessons from interview participants, the stress of the developmental mathematics classroom can be minimized by building relationships that foster connections between the developmental mathematics instructor and students. There are clearly instructors who possess the interpersonal skills, training, and experience that allow them to more easily connect with the developmental mathematics student and form exceptional classroom connections that foster student engagement and success; therefore, whenever possible, the selection process of the developmental mathematics instructors at the institutions should be comprised of instructors who have both an interest and success in
teaching developmental mathematics to incorporate the element of relationship building as a tenet of success in the developmental mathematics success model.

**Conclusion Four: The Developmental Mathematics Instructor**

The researcher concludes that the developmental mathematics instructor is a major pillar in developmental mathematics pathway success model. The developmental mathematics instructor is responsible for orchestrating and coalescing cutting-edge pedagogy, relationship building, and a class format that supports student success in developmental mathematics. Although it is not a typical practice of community colleges to hire developmental mathematics instructors on the basis of having an earned credential in mathematics education, the combination of the responses from the research participants revealed that the academic credential in education is not solely responsible for the success of the developmental mathematics student, but is a combination of the academic credential, along with the appropriate class format and an instructor who connects with developmental mathematics students. A developmental mathematics instructor with a background in instructional and pedagogical practices can support and foster student success in developmental mathematics. In the absence of an academic credential in education, an instructor with a mathematics degree (non-education) is also suitable to teach developmental mathematics with a high degree of success. Instructors without a background or credential in mathematics education should be equipped with the pedagogical and instructional skills by attending ongoing professional development and education opportunities that support teaching and learning.
Recommendations

The researcher offers the following recommendations for community college leaders based upon the research findings and the information shared by the interview participants. The recommendations fall into three primary categories: class format and technology, hiring and recruiting, and institutional practices. The research also offers recommendations for future research.

Class Format and Technology

The researcher recommends that community colleges incorporate the following practices into the advising and registration process for developmental mathematics students:

1. Do not offer developmental mathematics courses as an online option due to the inherent nature of the lack of study skills and mathematical deficiencies of many developmental mathematics students.

2. In addition to the face-to-face format for developmental mathematics courses, offer developmental mathematics courses as a hybrid (face-to-face plus online) option which ensures that students receive some degree of face-to-face instruction and that assessments are proctored.

3. Limit the number of offerings of hybrid developmental mathematics course to the upper-level developmental mathematics courses to ensure that the foundational skills needed to be successful in subsequent courses are acquired by the student.

4. Allow students to enroll in the upper-level hybrid option of the developmental mathematics classes only if the prerequisite course is completed with a grade of B or higher. In the absence of a grading schema that includes the letter grades A thru F, a certification from a previous mathematics instructor would be required.
5. To accommodate non-traditional students, offer additional evening and weekend courses, along with mini-semester hybrid courses.

**Hiring and Recruiting**

The researcher recommends that community colleges incorporate the following practices into their recruitment and hiring practices for developmental mathematics instructors:

1. When composing the job vacancy announcement for a developmental mathematics instructor, indicate that a credential in mathematics education is preferred as opposed to required.

2. Carefully examine applications, resumes and CVs to find evidence of each applicant’s experience and background in the use of educational pedagogy and instructional practices that enhance student success.

3. During the interview process, have instructors present a teaching demonstration that showcases their use of research-based instructional practices that enhance student engagement and learning and actively supports students’ learning styles.

4. Incorporate behavioral type interview questions during the interview that allow the interview panel to delve more deeply into the applicant’s use and integration of pedagogical practices that foster student learning.

5. When checking references for a finalist, be sure to inquire about specific examples of how the applicant made connections with his/her students and provide specific examples.

6. For a new faculty member who does not possess an educational credential, assign a veteran developmental mathematics instructor with the new instructor as a peer
mentor to provide support and guidance on incorporating and using pedagogical practices in the developmental mathematics classroom.

**Institutional Practices**

The researcher recommends that community colleges incorporate the following institutional practices to further support student success in developmental mathematics:

1. Implement a required attendance policy for all developmental mathematics classes to foster student success and engagement.
2. For students who accrue excessive absences and fail to meet established benchmarks, implement a policy that requires students to attend student support services tutoring before taking their final exam.
3. For students who are required to retake a developmental mathematics class more than twice, link developmental mathematics courses to a non-credit study skills course designed to teach students how to study for and learn mathematics that the repeating student is required to enroll.
4. Review student success and retention data each year to gauge how individual developmental mathematics instructors are performing, along with course satisfaction data. Use data to assist in the developmental mathematics class assignment process, along with assisting instructors to identify training and professional developmental opportunities that foster student success.

**Use of Results in Practice**

As a result of both the findings from the research study and current developmental mathematics success rates at his current institution, the researcher worked in collaboration with other institutional leaders to incorporate an institutional practice as part of the
institutional academic master plans that addresses student success in developmental mathematics. Institutional Practice (c) states: For students who are required to retake a developmental mathematics class more than twice, link developmental mathematics courses to a non-credit study skills course designed to teach students how to study for and learn mathematics that the repeating student is required to enroll.

**Future Research**

Research on the student success in developmental mathematics is not plentiful. Student success is a dynamic concept and there are multiple lens through which to view student success in developmental mathematics. This research study looked at student success through the lens of the developmental mathematics instructor based on their respective academic credential in mathematics education or mathematics (non-education). The findings from the study serve as potential avenues for further research.

This study did not look at student success from the students’ perspective. Although obtaining a better understanding of the pedagogical and instructional practices that developmental mathematics instructors use in their classrooms is extremely helpful in delving into the success challenges that plague developmental mathematics students, additional research that focuses on student interpretations of appropriate interventions that they feel will positively impact their success would be most beneficial to the body of knowledge on this topic.

In addition to volunteering for the study, the study participants self-identified as developmental mathematics instructors who were either at the excellence level or not. Such an identification process is clearly subjective. Along with the self-identification criteria, no bona-fide student success data outcomes were used in the selection process of the
developmental mathematics instructors. Further research on the pedagogical and instructional practices of developmental mathematics instructors who fall into specific categories based on student success and retention at the institutional level would further support and foster the understanding of the student success in developmental mathematics.

The research is very contradictory when it comes to student success in developmental mathematics courses that are purely offered in an online format. The participants in this study reiterated the challenges that offering online developmental mathematics presents for the developmental mathematics students. Clearly, some developmental mathematics students can be successful in developmental mathematics. But, the question remains of who these students are and why they have been successful. Further research on the phenomenon of online developmental mathematics is still needed to add to the body of knowledge on student success in developmental mathematics. A potential qualitative study that delves into both the instructional practices of instructors, along with student attributes and software integration, could shed light on the phenomenon of success in online developmental mathematics course offerings.

Research participants echoed the importance of the integrating study skills in with developmental mathematics on the basis that developmental education students do not self-regulate very well and do not possess the necessary skills to be successful in college-level academics. Additional research on student success that relates to the integration of a student success course that coincides with a developmental math course would add merit to the hypothesis that study skills will inevitably improve student success in developmental mathematics.
Summary

Chapter five concludes the research study by providing an introduction and overview of the study, support findings from the literature, conclusions, and recommendations. Excerpts from participant interviews were written juxtaposed to the findings from the literature in the areas of developmental mathematics, study skills, pedagogy, relationship building, classroom environment, and technology.

Four conclusions emerged from that data analysis that appeared to positively impact student success in developmental mathematics, namely, pedagogy and instruction, class format, relationship building, and the developmental mathematics instructor. Student success in developmental mathematics is a complex concept and no single variable is solely responsible for the student’s success in developmental. Student success in developmental mathematics is a concept built on the supports of each of emerging ideas in varying degrees. Chapter five closes with recommendations that for community colleges that relate to institutional practices, hiring practices and recruiting, and the developmental mathematics class format and the integration of technology that supplants developmental mathematics instruction.

Continual changes and advances in technology are resulting in more 21st century jobs that require the minimum of a college certificate, diploma, or degree. Community colleges inevitably pave the way for many students to complete their postsecondary education and earn a college credential (Cohen & Brawer, 2008; Price & Roberts, 2008) that leads to a career that pays a living wage. Not surprising, employees with a high school diploma or less are often limited to jobs that pay less than a living wage.
However, community colleges continue to enroll an increasing number of underprepared students, particularly in mathematics (Achieving the Dream, 2009; Parmer & Cutler, 2007; Stigler, Givvin & Thompson, 2009; U.S. GAO, 2013). The roadblock that mathematics creates for millions of community college students in pursuit of their academic credential is yet another opportunity for educators, policy makers, administrators, and students to work collegially to foster a proactive resolution to the mathematics sequence in terms of credential completion.

This research study utilized a qualitative case study research design to investigate the impact that faculty credentials have on student success in developmental mathematics at a community college. If this problem is not solved, then millions of students will continue stall in developmental mathematics without earning a college credential that will equip them for many 21st century jobs. The findings from this study revealed that student success is a complex phenomenon that is not resolved using any single approach, but is a compilation of various paradigms that look at success from the lens of students, faculty, institutions, and policy makers. This study revealed that from the purview of the instructor, student success is contingent upon continuous investigation and improvement of pedagogy and instruction, careful consideration of class format in conjunction with student learning styles, relationship building between instructor and students, and ongoing professional development and training for developmental mathematics instructors.
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APPENDICES
Appendix A: Materials for Identifying Participants

In this appendix, included are materials used for identifying participants. The materials include a request to conduct the research study, an informational letter request for individual, face-to-face interviews, an informational letter request to participate in a focus group, and a flyer to wide distribution.
Sample Letter: Permission to Conduct Research

Date
Agency Representative
Name of Institution
Address
RE: Permission to Conduct Research Study

Dear Mr./Ms/Mrs. X:

Greetings! My name is Calvin Stansbury and I am a doctoral student in Adult and Community College Education at North Carolina State University in Raleigh, North Carolina. I am in the process of writing my dissertation. My dissertation topic is *The Impact of Faculty Credentials on Student Success In Developmental Mathematics at a Community College: A Case Study*. The purpose of this study is to understand the impact that the academic credential of developmental mathematics instructors has on student success in developmental mathematics and to assess the similarities and differences in instructional practices of developmental mathematics instructors based on whether their credential is in mathematics (non-education) or mathematics (education).

I am writing to request permission to conduct a research study at your institution. The research study will entail interviewing individual developmental mathematics instructors about their instructional practices and conducting a focus group of developmental mathematics about their instructional strategies, classroom settings, and educational ideologies. It is my hope that the school administration will allow me to recruit developmental mathematics instructors from your institution to participate in individual interviews and as part of a focus group. Due to the nature of the study, developmental mathematics faculty who volunteer to participate will be given a consent form to be signed and returned to the primary researcher at the beginning of the interview and focus group process.

If approval is granted, individual faculty participants will be interviewed in a setting of their choosing, either on-campus or off-campus. The interview should last approximately 1 hour. Recruitment for the focus group will be solicited using an invitational flyer and will last approximately an hour. The interview responses and focus group responses will be pooled for the dissertation results of this study and will remain absolutely confidential and anonymous. No costs will be incurred by either your school/center or the individual participants.

Your approval to conduct this study will be greatly appreciated. I will follow up with a telephone call next week and would be happy to answer any questions or concerns that you may have at that time. You may contact me at my email address: cestansb@ncsu.edu.
If you agree, kindly sign below and return the signed form in the enclosed self-addressed envelope. Alternatively, kindly submit a signed letter of permission on your institution’s letterhead acknowledging your consent and permission for me to conduct this survey/study at your institution.

Sincerely,

Calvin E. Stansbury

Doctoral Student – North Carolina State University

Approved by:

_________________________  ____________________________  ______

Print your name and title here  Signature  Date

Enclosures

Invitation Letters
Invitation Letter A (Individual Interview)

Developmental Mathematics Instructor (Non-education degree)

Dear Mr./Mrs. ____________________

My name is Calvin Stansbury and I am a doctoral student in Adult and Community College Education at North Carolina State University. I am writing to invite you to volunteer to participate in a research study about the role of the academic credential of developmental mathematics faculty on student success in developmental mathematics as part of a research study for my doctoral dissertation. My dissertation topic is The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study. The purpose of this case study is to understand the impact that the academic credential of the developmental mathematics instructors has on student success in developmental mathematics and assess the similarities and differences in instructional practices of developmental mathematics instructors based on whether their credential is either a mathematics (non-education) or mathematics education degree. You have been identified as a potential research participant based on your mathematics (non-education) academic credential.

This research is significant because developmental mathematics continues to be a major hurdle for many community college students despite curriculum changes and redesign initiatives. As an individual who sees the challenges of developmental mathematics “up close and personal” on a daily basis, your insights will prove valuable to this research study in an effort to continue to ensure change that helps developmental mathematics students.

I would like to conduct a one hour-long, face-to-face interview with you at a location of your choice. With your permission, the interview will be audio recorded and later transcribed. After the interview is transcribed, I would like to send you a copy of the transcript of our conversation for your review (via US Postal Service, along with a post-paid envelope for its return) that may take an hour to review. To protect your privacy, your name will not be used in the transcript or in the research report, nor will the institution in which this research is being conducted be identified in any reports. You will choose a pseudonym that will be used connect interview responses.

If you would be willing to participate in this research study, please let me know by return email and I will send you a copy of the consent form, along with the selection of the a date, a time, and a location that best fits your schedule. As a convenience, I have included my contact information at the end of this letter.

Rest assured that your interview responses will be held in the strictest of confidence. The identity of the community college and your individual identity will be kept confidential when published in any reports. All data collected during the research study will be stored and locked in my home office when not in use.

I would appreciate a response by September 30, 2017.
For questions regarding the right of research participants, any complaints or comments regarding the manner in which the study is being conducted, you may contact the North Carolina State University Office of Sponsored Programs and Regulatory Compliance at (919) 515 – 2444, 2701 Sullivan Drive, Suite 240, Campus Box 7514, Raleigh, NC 27695-7514

If you have any questions about this study, please contact:

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Invitation Letter B (Individual Interview)

Developmental Mathematics Instructor (Education degree)

Dear Mr./Mrs. _______________________________________

My name is Calvin Stansbury and I am a doctoral student in Adult and Community College Education at North Carolina State University. I am writing to invite you to volunteer to participate in a research study about the role of the academic credential of developmental mathematics faculty on student success in developmental mathematics as part of a research study for my doctoral dissertation. My dissertation topic is *The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study.* The purpose of this case study is to understand the impact that the academic credential of the developmental mathematics instructors has on student success in developmental mathematics and assess the similarities and differences in instructional practices of developmental mathematics instructors based on whether their credential is either a mathematics (non-education) or mathematics education degree. You have been identified as a potential research participant based on your mathematics education academic credential.

This research is significant because developmental mathematics continues to be a major hurdle for many community college students despite curriculum changes and redesign initiatives. As an individual who sees the challenges of developmental mathematics “up close and personal” on a daily basis, your insights will prove valuable to this research study in an effort to continue to ensure change that helps developmental mathematics students.

I would like to conduct a one hour-long, face-to-face interview with you at a location of your choice. With your permission, the interview will be audio recorded and later transcribed. After the interview is transcribed, I would like to send you a copy of the transcript of our conversation for your review (via US Postal Service, along with a post-paid envelope for its return) that may take an hour to review. To protect your privacy, your name will not be used in the transcript or in the research report, nor will the institution in which this research is being conducted be identified in any reports. You will choose a pseudonym that will be used connect interview responses.

If you would be willing to participate in this research study, please let me know by return email and I will send you a copy of the consent form, along with the selection of the a date, a time, and a location that best fits your schedule. As a convenience, I have included my contact information at the end of this letter.

Rest assured that your interview responses will be held in the strictest of confidence. The identity of the community college and your individual identity will be kept confidential when published in any reports. All data collected during the research study will be stored and locked in my home office when not in use.

I would appreciate a response by **September 30, 2017.**
For questions regarding the right of research participants, any complaints or comments regarding the manner in which the study is being conducted, you may contact the North Carolina State University Office of Sponsored Programs and Regulatory Compliance at (919) 515 – 2444, 2701 Sullivan Drive, Suite 240, Campus Box 7514, Raleigh, NC 27695-7514

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<td><a href="mailto:Jebartl3@ncsu.edu">Jebartl3@ncsu.edu</a></td>
</tr>
</tbody>
</table>
Focus Group Participant Invitation

Dear Mr./Mrs. ____________________________

My name is Calvin Stansbury and I am a doctoral student in Adult and Community College Education at North Carolina State University. I am writing to invite you to volunteer to participate in a research study about the role of the academic credential of developmental mathematics faculty on student success in developmental mathematics as part of a research study for my doctoral dissertation. My dissertation topic is *The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study*. The purpose of this case study is to understand the impact that the academic credential of the developmental mathematics instructors has on student success in developmental mathematics and assess the similarities and differences in instructional practices of developmental mathematics instructors based on whether their credential is either a mathematics (non-education) or mathematics education degree. You have been identified as a potential focus group participant based on the work as a developmental mathematics instructor in the community college system. Participation in this research study is on a volunteer basis and your participation will, in no way, impact your standing or role as a developmental mathematics instructor.

This research is significant because developmental mathematics continues to be a major hurdle for many community college students despite curriculum changes and redesign initiatives. As an individual who sees the challenges of developmental mathematics “up close and personal” on a daily basis, your insights will prove valuable to this research study in an effort to continue to ensure change that helps developmental education students.

I would like to conduct an hour long focus group session of developmental mathematics instructors on a date/time and location that is convenient for you. With your permission, the focus groups session will be audio recorded and later transcribed. At the conclusion of the focus group, I would like to send you a copy of the transcript of our conversation for your review (via US Postal Service, along with a post-paid envelope for its return) that may take an hour or more to review. To protect your privacy, your name will not be used in the transcript or in the research report, nor will the institution in which this research is being conducted be identified in any reports. You will choose a pseudonym that will be used for your focus group comments.

If you would be willing to participate in this research study, please let me know by return email and I will send you a copy of the consent form, along with the selection of the a date, a time, and a location that best fits your schedule. You will be asked to return the saved consent form, complete your name/date and return it to me via email. As a convenience, I have included my contact information at the end of this letter.
Rest assured that the focus group responses will be held in the strictest of confidence. The identity of the community college and your individual identity will be kept confidential when published in any reports. You should be aware that that the confidentiality of your focus group responses cannot be guaranteed because the researcher does not have control over what group members discuss outside of the group. All data collected during the research study will be stored and locked in my home office when not in use.

I would appreciate a response by **September 30, 2017**.

For questions regarding the right of research participants, any complaints or comments regarding the manner in which the study is being conducted, you may contact the North Carolina State University Office of Sponsored Programs and Regulatory Compliance at (919) 515 – 2444, 2701 Sullivan Drive, Suite 240, Campus Box 7514, Raleigh, NC 27695-7514

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<td><a href="mailto:Jebartl3@ncsu.edu">Jebartl3@ncsu.edu</a></td>
</tr>
</tbody>
</table>

Thanks for your time, and I hope that you decide to participate in this research study.
Focus Group Participant Flyer

VOLUNTEERS NEEDED!

Seeking

Developmental Mathematics Instructors
to participate in a FOCUS GROUP

PURPOSE: To discuss the instructional strategies, classroom setting, and that educational ideology of the developmental mathematics instructors that promote student success.

ELIGIBILITY:

- Possess a degree in either mathematics or mathematics education
- Currently employed as a Developmental Mathematics Instructor
- Employed in the North Carolina community college setting

TO PARTICIPATE IN THE FOCUS GROUP, CONTACT

Calvin E. Stansbury, Researcher

252-578-0884
cestansb@ncsu.edu
Appendix B: Consent Forms

This appendix contains consent forms given to research participants prior to being interviewed and participating in the focus group.
Title of Study: The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study

Principal Investigator: Calvin Earl Stansbury
Faculty Sponsor: Dr. James E. Bartlett, II

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate, or to stop participating at any time without penalty. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form, it is your right to ask the researcher to explain it or provide more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher.

What is the purpose of this study?
You are invited to participate in a research study designed to understand the instructional strategies used by developmental mathematics instructors as tools to promote student success in developmental mathematics based on the academic credential of the developmental mathematics instructor. Developmental mathematics students at the community college level are taught by developmental mathematics instructors who possess either a mathematics degree (non-education) or a mathematics (education) degree. This research is important because there developmental mathematics student continue to struggle to advance to their respective curriculum mathematics courses and little qualitative research on the impact that faculty credentials have on student success in developmental mathematics.

What will happen if you take part in this study?
If you agree to participate in this study will be asked to participate in a face-to-face interview in a location of your choosing. The location should be a place that is private and that you feel comfortable speaking without being overheard. It is expected that you will participate in an interview that will last between one and two hours and participate in a follow-up interview, if necessary. I am requesting that you allow me to audiotape this interview. After the interviews have been transcribed, I will ask you to review the transcripts for accuracy. I will send you the transcript via US Postal Service, along with a postage-paid envelope for its return and ask you to return the transcripts for accuracy. If more information is needed after the interview, I may ask you follow-up questions via telephone and/or email. The interviews will be conducted during the fall of 2017.

RISKS
Although risk for you as a participant is minimal, I will be asking questions about your work as a developmental mathematics instructor. In this study, there may be minimal discomfort or stress due to participation. Minimal risks refer to those that are no greater that those ordinarily encountered in daily life. I will remind you before we begin the interview that you can stop at any
time or skip any questions you do not want to answer. During the interviews, some sensitive information may be revealed. It is possible that something said by yourself or by another developmental mathematics instructor about your discipline that could be professionally damaging should those statements get out. Efforts to minimize such a breach have been added to the research protocol which include not mentioning the name of the state or the college where the research will be conducted in any of the written reports. Additionally, pseudonyms will also be used in the written report for all parties involved. To ensure confidentiality of your responses, you name and any other identifiers associated with you personally will not be used, nor will the name of the state and the specific community college being studied be mentioned in written research report. Your name and any other identifiers associated with you personally will not be used.

**BENEFITS**

This study will document your experiences as a developmental mathematics faculty member at a community college. You will not benefit directly from the research. However, the experiences you share may provide insight into how to best serve developmental mathematics students by ensuring that developmental mathematics instructors are equipped with the pedagogical strategies that closely align with the needs of developmental mathematics students.

**CONFIDENTIALITY**

Your confidentiality will be maintained at all times throughout the research. Your name and any other identifiers associated with you personally will not be used. I will remind you before we begin the interview that you may stop at any time. Audiotapes from the interviews will be retained throughout the research, and destroyed three years after the study. Identifiers will be removed from study data such as transcripts and interview notes. Data will be stored securely in a locked file cabinet. No reference will be made in oral or written reports which could link you to the study. Pseudonyms (fake names) will be assigned to all participants.

**COMPENSATION**

You will receive a $15 Walmart gift card for your participation in this study. If a research participant withdraws from the study prior to its conclusion, the participant will not receive the $15 WalMart gift card.

**CONTACT**

If you have questions at any time about the study or the procedures, you may contact the researcher, Calvin E. Stansbury at cestansb@ncsu.edu or 252-578-0884.

**PARTICIPATION**

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled.

**RIGHTS**

If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact the North Carolina State University Office of Sponsored Programs and Regulatory Compliance at (919) 515 – 2444, 2701 Sullivan Drive, Suite 240, Campus Box 7514, Raleigh, NC 27695-7514.
CONSENT
I have read and understand the above information. I have received a copy of this form. I agree to participate in this study while understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits to which I am otherwise entitled.

Subject’s signature______________________________________ Date___________________

Investigator’s signature___________________________________ Date___________________
Focus Group Participant Consent Form

INFORMED CONSENT FORM for RESEARCH

Title of Study: The Impact of Faculty Credentials on Student Success in Developmental Mathematics at a Community College: A Case Study

Principal Investigator: Calvin Earl Stansbury
Faculty Sponsor: Dr. James E. Bartlett, II

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate, or to stop participating at any time without penalty. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form, it is your right to ask the researcher to explain it or provide more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher.

What is the purpose of this study?
You are invited to participate in a research study designed to understand the instructional strategies used by developmental mathematics instructors as tools to promote student success in developmental mathematics based on the academic credential of the developmental mathematics instructor. Developmental mathematics students at the community college level are taught by developmental mathematics instructors who possess either a mathematics degree (non-education) or a mathematics (education) degree. This research is important because there developmental mathematics student continue to struggle to advance to their respective curriculum mathematics courses and little qualitative research on the impact that faculty credentials have on student success in developmental mathematics.

What will happen if you take part in this study?
If you agree to participate in this study, you will be asked to participate in a focus group. You will be asked some questions which can be answered and discussed with your peers who will also be part of the focus group. The location of the focus group will be held in a location at the research institution that will allow privacy so that the focus group participants feel comfortable. The focus group will last approximately 1 hour and will be audio-digitally recorded, using only the pseudonyms you have selected. I am requesting that you allow me to audiotape the focus group. After the interviews have been transcribed, I will ask you to review the transcripts for accuracy. You will have the opportunity to review the focus group transcript you participated in and can make modifications or changes. I will send you the transcript via US Postal Service, along with a postage-paid envelope for its return and ask you to return the transcripts for accuracy. Modifications can be sent via mail to the researcher at the address on the return envelope. I will store that tapes in my home office and will destroy the tapes after three years. These are standard procedures for focus groups.

RISKS
Although risk for you as a participant is minimal, I will be asking questions about your work as a developmental mathematics instructor. In this study, there may be minimal discomfort or stress due to participation. Minimal risks refer to those that are no greater that those ordinarily encountered in daily life. I will remind you before we begin the interview that you can stop at any time or skip any questions you do not want to answer. During the interviews, some sensitive information may be revealed. It is possible that something said by yourself or by another developmental mathematics instructor about your discipline that could be professionally damaging should those statements get out. Efforts to minimize such a breach have been added to the research protocol which include not mentioning the name of the state or the college where the research will be conducted in any of the written reports. Additionally, pseudonyms will also be used in the written report for all parties involved. To ensure confidentiality of your responses, you name and any other identifiers associated with you personally will not be used, nor will the name of the state and the specific community college being studied be mentioned in written research report. Your name and any other identifiers associated with you personally will not be used.

**BENEFITS**
This study will document your experiences as a developmental mathematics faculty member at a community college. You will not benefit directly from the research. However, the experiences you share may provide insight into how to best serve developmental mathematics students by ensuring that developmental mathematics instructors are equipped with the pedagogical strategies that closely align with the needs of developmental mathematics students.

**CONFIDENTIALITY**
Every attempt will be made to ensure that your responses are kept confidential; however, absolute confidentiality cannot be assured since I do not have control over what group participants may discuss outside of the focus group. Your name and any other identifiers associated with you personally will not be used. Pseudonyms (fake names) will be assigned to all focus group participants. I will remind you before we begin the interview that you may stop at any time. Audiotapes from the interviews will be retained throughout the research, stored off-site in my home office in a locked file cabinet, and subsequently destroyed three years after the study. Identifiers will be removed from study data such as transcripts and interview notes. No reference will be made in oral or written reports which could link you to the study.

**COMPENSATION**
You will receive a $15 Walmart gift card for your participation in this study. If a research participant withdraws from the study prior to its conclusion, the participant will not receive the $15 WalMart gift card.

**CONTACT**
If you have questions at any time about the study or the procedures, you may contact the researcher, Calvin E. Stansbury at cestansb@ncsu.edu or 252-578-0884.

**PARTICIPATION**
Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled.
RIGHTS
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact the North Carolina State University Office of Sponsored Programs and Regulatory Compliance at (919) 515 – 2444, 2701 Sullivan Drive, Suite 240, Campus Box 7514, Raleigh, NC 27695-7514.

CONSENT
I have read and understand the above information. I have received a copy of this form. I agree to participate in this study while understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits to which I am otherwise entitled.

Subject's signature______________________________________ Date___________________

Investigator‘s signature___________________________________ Date___________________
Appendix C: Interview Protocols

This appendix contains the interview protocol questions used for the face-to-face interview and the focus group session.
Interview Guide (Individual)

Participant-Chosen Pseudonym:

Date:

Location:

Start Time: End Time:

Introduction:

1. Explain how instructors are assigned to teach developmental mathematics at your institution.

2. In addition to developmental mathematics courses, do you also teach curriculum mathematics course?

RQ1: What are the pedagogical practices of developmental mathematics instructors who have a either a mathematics education or mathematics (non-education) degree?

1. What pedagogical practices do you utilize to promote student success and engagement in developmental mathematics?

2. What pedagogical practices are least effective in the teaching of developmental mathematics students?

RQ2: How are the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree SIMILAR to developmental mathematics instructors who earned a mathematics (non-education) degree?
1. What should developmental mathematics instructors do to promote student success in developmental mathematics?

2. How do you feel about developmental mathematics as a discipline?

3. Explain the greatest challenges confronting developmental mathematics students in the 21st century community college.

4. How does the instructional delivery format (traditional (F2F or online) of the developmental mathematics class impact student success?

5. The demographics, learning styles, and technological skills of developmental mathematics students continue to change, does your approach to teaching developmental mathematics students change to meet the needs of that changing population? If so, explain.

6. How does the developmental mathematics classroom (as an environment) support the pedagogical practices of the developmental mathematics instructor to promote success?

7. How does the developmental mathematics classroom environment (as an environment) create stress for the developmental mathematics student?

8. How do you promote/provide an engaging, non-threatening environment for developmental mathematics students?
9. Are there additional things you can do to ensure that the developmental mathematics space (environment) is conducive for learning for the developmental mathematics students?

RQ3: How are pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who earned a mathematics education degree DIFFERENT than those utilized by developmental mathematics instructors who earned a mathematics (non-education) degree?

1. What should developmental mathematics instructors do to promote student success in developmental mathematics?

2. How do you feel about developmental mathematics as a discipline?

3. Explain the greatest challenges confronting developmental mathematics students in the 21st century community college.

4. How does the instructional delivery format (traditional F2F or online) of the developmental mathematics class impact student success?

5. The demographics, learning styles, and technological skills of developmental mathematics students continue to change, does your approach to teaching developmental mathematics students change to meet the needs of that changing population? If so, explain.

6. How does the developmental mathematics classroom (as an environment) support the pedagogical practices of the developmental mathematics instructor to promote success?
7. How does the developmental mathematics classroom environment (as an environment) create stress for the developmental mathematics student?

8. How do you promote/provide an engaging, non-threatening environment for developmental mathematics students?

9. Are there additional things you can do to ensure that the developmental mathematics space (environment) is conducive for learning for the developmental mathematics students?

RQ4: How do the pedagogical practices, classroom settings, and educational ideologies of developmental mathematics instructors who “self-report” high student pass rates differ from developmental mathematics instructors who do not “self-report” high pass rates?

1. What should developmental mathematics instructors do to promote student success in developmental mathematics?

2. How do you feel about developmental mathematics as a discipline?

3. Explain the greatest challenges confronting developmental mathematics students in the 21st century community college.

4. How does the instructional delivery format (traditional F2F or online) of the developmental mathematics class impact student success?
5. The demographics, learning styles, and technological skills of developmental mathematics students continue to change, does your approach to teaching developmental mathematics students change to meet the needs of that changing population? If so, explain.

6. How does the developmental mathematics classroom (as an environment) support the pedagogical practices of the developmental mathematics instructor to promote success?

7. How does the developmental mathematics classroom environment (as an environment) create stress for the developmental mathematics student?

8. How do you promote/provide an engaging, non-threatening environment for developmental mathematics students?

9. Are there additional things you can do to ensure that the developmental mathematics space (environment) is conducive for learning for the developmental mathematics students?
Interview Guide (Focus Group)

Date:

Location:

Start Time: End Time:

1. What role does the developmental mathematics instructor’s academic credential have on student success in developmental mathematics?

2. Are developmental math instructors who possess an educational credential better suited to teach developmental mathematics at the community college?

3. Should developmental math instructors at the community college be required to possess an educational credential to teach developmental mathematics?

4. What can developmental mathematics instructors, as a collective body, do to promote student success in developmental mathematics?

5. What factors inhibit student success in developmental mathematics and are beyond the developmental math instructors’ locus of control?

6. What overall perception do developmental mathematics instructors have about developmental mathematics students?

7. As the developmental mathematics classroom demographic continues to change, what can institutions do to support developmental mathematics instructors?

8. How much annual professional developmental is necessary to ensure that developmental mathematics instructors are equipped with the most up-to-date information on working with and ensuring the success of developmental mathematics students?
9. Explain how contextualized and “skill and drill” exercises are used in the developmental mathematics classroom.

PEDAGOGY
1. What pedagogical practices should developmental mathematics instructors utilize to promote student success and student engagement?
2. What pedagogical practices should developmental mathematics instructors utilize to promote student success?
3. What pedagogical practices are least effective in the teaching of developmental mathematics students?

DEVELOPMENTAL MATH STUDENTS
1. How can developmental mathematics instructors help to improve the self-efficacy of developmental mathematics students?
2. What do developmental mathematics students need to do to ensure and promote their success in developmental mathematics?
3. The demographic of the developmental mathematics instructor continues to change, how does your approach to teaching and learning developmental mathematics students change to meet the needs of that changing population?

CLASSROOM/ENVIRONMENT
1. As an environment, how does the developmental mathematics classroom create stress for developmental mathematics students?
2. As an environment, are there strategies that developmental mathematics instructors can assimilate into the developmental mathematics classroom that mitigate stress for students?
3. Are there additional things that developmental mathematics instructors can do to ensure that the developmental mathematics space (environment) is conducive for learning for the developmental mathematics students?

STUDENT MOTIVATION AND ENGAGEMENT

1. What strategies do you use to actively engage developmental mathematics students?

2. What technique and strategies do you use to motivate students in developmental mathematics?
Appendix D: Code List

This appendix contains the list of list codes derived from the individual interviews and the focus group. Coding was done using the Atlas.ti 8.1.0.
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<td>Instruction and Pedagogy</td>
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<tr>
<td>Light Green</td>
<td>Algorithm/Rote Memory/Memorized Steps</td>
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<td>Instruction and Pedagogy</td>
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<td>Dark Green</td>
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<td>Student Barrier</td>
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<td>Orange</td>
<td>Application relevance to career</td>
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<td>Relationship Building</td>
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<td>Orange</td>
<td>Build student confidence/self-esteem</td>
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<td>Calculator Useage</td>
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<td>cheerleader/facilitator</td>
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<tr>
<td>Light Blue</td>
<td>Class choice</td>
<td>8</td>
<td>Developmental Mathematics Instructor</td>
</tr>
<tr>
<td>Gray</td>
<td>class Format (Hybrid, Online, Traditional)</td>
<td>3</td>
<td>Format</td>
</tr>
<tr>
<td>Turquoise</td>
<td>Classroom Engagement</td>
<td>4</td>
<td>Instruction and Pedagogy</td>
</tr>
<tr>
<td>Light Green</td>
<td>Classroom environment - stressful/non-threatening</td>
<td>19</td>
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<td>Light Blue</td>
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<td>Compromise in helping students</td>
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<tr>
<td>Pink</td>
<td>Developmental does not prepare students for curriculum courses</td>
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<td>Getting to Know students without math</td>
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<td>Have fun with math</td>
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<tr>
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<td>Homogenous/Heterogenous grouping</td>
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<td>Instructors need pedagogical training to help developmental math students</td>
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<td>Interpersonal Relationships</td>
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<td>Invalid placement</td>
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<td>It is detrimental to advance students past DM if the student needs it</td>
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<td>Lack of clear direction/instruction</td>
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<td>Not having a math ed degree has no impact on student success</td>
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<td>Working in Groups</td>
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