COMMUNITY COLLEGE STUDENTS’ ACADEMIC SUCCESS AND PERSISTENCE IN MATH COURSES AFTER DEVELOPMENTAL MATH: A CASE STUDY

by

Robin Naifeh Bontrager

Liberty University

A Dissertation Presented in Partial Fulfillment

Of The Requirements for the Degree

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ABSTRACT

This qualitative research study was a bounded case study exploring how and why community college students achieved academic success after completion of the developmental math sequence and a college level math course. The purpose of this research was to explore how and why community college students were academically successful in college algebra or elementary statistics after completion of the developmental math sequence. For the purpose of this study, the students’ changes in behavior that influenced academic success and persistence in their math courses were generally defined as involvement in academic support programs, integration into social groups, and the perception of their ability to perform in the college level math curriculum. Throughout this study, the intent was to explore the participants’ historical and social perspective through their descriptions and perceptions from developmental math through college algebra or elementary statistics. Data collection consisted of surveys, interviews, field notes, archival data, and a focus group session. Themes emerged after repetitive, rigorous listening of the interviews and focus group session; in addition, rereading the transcriptions allowed for immersion into the data. The themes that emerged were (a) ability to succeed, (b) academic support, (c) involvement and behavior changes, and (d) connectedness to faculty. The findings indicated that students’ perception of their ability to succeed, self-motivation, family support, faculty relationships, and academic support were all contributing factors of students’ achieving academic math success.

Keywords: college readiness, developmental math sequence, remedial math course
Dedication

I dedicate this work to Greg, my husband and Allie and Erin, my two daughters. When I was weak, you were strong. Your encouraging words became my river and your sacrifices became my rock to complete this educational goal. I love you.

To my fur babies; Ryan (who left us too soon), Kodi, Buttons, Gracie, and Skipper you kept me company while I worked many hours at the computer desk. You were always faithful and ready for a pat on the head.

In memory of my family who did not see this work to completion: Russell Woods, my brother, Harvey Bontrager, my father-in-law, and Ruthie Woods, my momma. I miss you.
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I want to acknowledge and thank the community college’s professors, staff, president, and students who helped in the data collection process.
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List of Abbreviations

Baptist Collegiate Ministry (BCM)
Computer-Assisted Instruction (CAI)
Common Core State Standards (CCSS)
Computer-adaptive Placement Assessment and Support System (COMPASS)
Institution Review Board (IRB)
Learning Resource Center (LRC)
National Assessment of Educational Progress (NAEP)
Self-Regulated Learning (SRL)
Science, Technology, Engineering, and Mathematics (STEM)
Tennessee Board of Regents (TBR)
Technology and Engineering Literacy (TEL)
CHAPTER ONE: INTRODUCTION

Overview

In this chapter, the background and significance of the study are presented. The problem and purpose statements are stated. Next, an overview of the research plan is explained. In addition, this chapter offers the delimitations and definitions of key terms are discussed. Lastly, a summary completes this chapter.

Background

In America, developmental education was initiated more than 375 years ago when Harvard began a remedial class to teach reading to adults (Wolfe, 2012). At the University of Wisconsin at Madison, “only 41 of the 331 admitted students in 1865 were enrolled in college level courses” while the others were enrolled in an “academic preparatory academy” (Arendale, 2002, p. 5). Community colleges offered developmental education courses to academically strengthen students who were enrolling into college and were not ready for the challenges of college coursework (Bahr, 2008; Bailey, 2009).

Pretlow and Wathington (2012) stated that developmental education programs have gained national attention due to the high cost of developmental education and community colleges accepting every student who applies. In addition, each year, state and federal governments spend billions of tax dollars on developmental education programs in higher education institutions. President Obama allocated 12 billion dollars to community colleges to help boost the retention and graduation rate (Marklein & Gray, 2009). Students with a strong math background are better prepared for many areas of the U. S. economy and stakeholders are looking for workers who are mathematically capable (Moore & Shulock, 2009).
Initially, the main focus of developmental math was to remediate students; however, it has evolved into skill development (Brothen & Wambach, 2012). Educators have broadened developmental math to provide academic support for all students who need or benefit from it. Community college faculty is faced with the responsibility of remediating and building the math skills in students so that they may enroll in college level math courses (Martinez & Bain, 2013).

In 2009, 60% of all first-time freshmen community college students required a minimum of one developmental course (National Center for Educational Statistics, 2009). Math, reading, and writing were the three areas of developmental courses offered to students at post-secondary educational institutions. In 2011, the number of incoming freshmen students who are underprepared for college has grown; 80% of incoming freshmen were placed in one of the developmental education programs (Bahr, 2012a). Furthermore, students who do not complete the developmental math sequence are more likely to drop-out of college or choose a vocational certification that does not require math competency than those students who complete the developmental math sequence (Bahr, 2012a; Crynes, 2013; Engstrom & Tinto, 2008; Fike & Fike, 2012; Hodara & Jaggers, 2014; Melguizo, Bos, & Prather, 2011).

Albert Einstein (2005) said, "Once we accept our limits, we go beyond them" (p. 65). This quote speaks to the nature of many community college students’ academic success and persistence in the developmental math sequence because these students accept their limitations and then progress on to college level math courses. Therefore, getting students to accept and push past these limits is vital to academic success after completion of the developmental math sequence. In 2011, there were 7.5 million students enrolled in community colleges (Knapp, Kelly-Reid, & Ginder, 2012). Sixty-seven percent of all community college freshmen are placed in a developmental math sequence (Bailey, Jeong, & Cho, 2010). In addition, seventy-five
percent of the community college students who are enrolled in a developmental math sequence do not earn a passing grade and finish the course (Bahr, 2012a; Bailey, 2009; & Fain, 2012). Developmental or remedial math is a course for students who are underprepared for college level math courses.

Although, there is no difference in the meaning of the terms developmental or remedial, developmental math has been used more frequently in current literature. The renaming has occurred to camouflage the negative connotations regarding remedial math, basic skills, or college readiness classes (Voge, 2008). In this study, developmental math was used as the term to identify courses that are below college level. First-time degree-seeking students under the age of 21 were assessed on the basis of their ACT scores. According to the community college where the research took place, students with an ACT subscore of 21 or below on the mathematics portion were considered to have below college level skills and required to enroll in the developmental math sequence (TCC (pseudonym), 2013).

**Problem Statement**

The current research was designed to find out why as well as how community college students were academically successful and persisted in college algebra or elementary statistics after completion of the developmental math sequence. There are more individuals enrolling in community colleges than ever before and the number of students who are not ready for college level courses is growing (Bahr, 2012b; Hodara & Jaggers, 2014; Knapp, Kelly-Reid, & Ginder, 2012). Quantitative research studies have shown that there is a rise in community college students who are not ready for college level courses and two-thirds of these students do not become academically successful and persist in their education (Bahr, 2012a, 2012b; Bailey, 2009; Butcher & Visher, 2013; Fain, 2012; Wolfe, 2012). Between 2000 and 2009, community
college’s enrollment increased 25% (from 5.7 to 7.1 million students). In 2011, 7.5 million students were enrolled in public community colleges which was a 5% increase over the two year period.

Similarly, at the community college where the research took place, enrollment has increased an average of 29% over the past four years (TCC (pseudonym), 2013). Between 2010 and 2012, the number of students enrolled in the developmental math sequence has increased by 27% with a completion rate of 63.2%. According to the community college’s fact sheet, the retention rate is at 44% for the students in a developmental education sequence (TCC (pseudonym), 2013).

Li et al. (2013) examined the “effects of math readiness and student course behavior” on academic success in the developmental math sequence especially the courses that are non-credited (p. 14). According to the researchers, 45% of community college students do not remain enrolled for the first 2 years; in addition, only 28% of community college students earn a certificate or degree within 6 years of enrollment.

Financial burdens due to cost of books and tuition, which may not be covered by financial assistance, lack of academic skills, and low self-esteem are challenges that students face when they are not prepared for college level courses (Bahr, 2012a; Bettinger, Boatman, Long, 2013; Bisk, 2013; Halcrow & Iiams, 2011; LaManque, 2009). Halcrow and Iiams (2011) stated students who are struggling in the developmental math sequence encounter challenges in finding assistance in math learning centers or hiring an individual tutor.

Bahr (2012a) found that students who were in the developmental math sequence possess a broad range of academic skill levels. Students were identified as having low skill levels and high skill levels. Students with low skill levels faced the challenge of passing the developmental
math sequence, while the students with high skill levels were more likely to pass the developmental math courses and remain in college.

LaManque (2009) suggested that community colleges use computer-assisted instruction (CAI) to boost the academic success of the students in need of the developmental math sequence and to reduce the challenges of not being prepared for college level courses.

There have been quantitative studies regarding students in the developmental math sequence; however, few studies address students’ academic success in the college level math courses after completion of the developmental math sequence (Bahr, 2012a, 2012b; Bailey, 2009; Bailey, Jeong, & Cho, 2010; Boylan, Bliss, & Bonham, 1997; Fain, 2012; & Wolfe, 2012). The problem is in the lack of academic success and persistence of community college students who began in the developmental math sequence and never enrolled in college level math courses; however, some students achieve academic success in college level math courses. Thus, there was a need for future research to explore why and how community college students were academically successful and persistent in the developmental math sequence and continued success in college algebra or elementary statistics.

**Purpose Statement**

The purpose of this qualitative case study was to explore how and why changes in students’ behavior influenced academic success and persistence in their math courses at the community college level. The current research identified how students who were placed in developmental math programs became successful; this may be beneficial to students, parents, educators, administrators, and community stakeholders. As a result of this research, parents and educators may become aware of specific supports that will improve students’ academic achievement and persistence in math.
For the purpose of this study, the students’ changes in behavior that improved academic success and persistence in their math courses were generally categorized as involvement in academic support programs, integration into social groups, and improved perception of their ability to perform in the community college’s math curriculum. The current research study addressed a gap in the literature; few qualitative research studies have conducted studies to address the how and why some students were academically successful in college algebra or elementary statistics after completing the developmental math sequence (Bachman, 2013; Koch, Slate, & Moore, 2012).

This qualitative case study attempted to explore the influences that enabled academic success and persistence for community college math students. A case study was suitable for gaining insight and understanding of how and why community college students were successful in college level math courses after completing the developmental math sequence (Stake, 1995). The phenomena weaved in this case study were the math success and persistence of community college students who began their post-secondary math education in the developmental math sequence. The setting was at a community college in Tennessee. The selection of participants was a purposeful sampling of community college students who successfully completed the developmental math sequence and college algebra or elementary statistics. Academic success was defined as earning a grade of a C or higher (Crynes, 2013; Reyes, 2010).

The researcher hoped this study served to empower students who achieved academic success after being placed in developmental math by giving them an avenue to voice their journeys and possibly inform future community college students of ways to succeed.
Significance of the Study

The significance of this study was to provide a voice for community college students who have experienced academic success in college algebra or elementary statistics after completion of the developmental math sequence. My goal as the researcher was to explore the influences that led the students to complete college level math courses after being placed in the developmental math sequence. This research study may be beneficial to other students and their parents to better prepare for college and the academic journey that lies ahead. Educators, administrators, and stakeholders may use the results of this study to empower other students who are faced with the same journey of beginning their college experience in the developmental math sequence.

The research focused on how and why community college students who have demonstrated academic success in the developmental math sequence continued academic success and persistence in college algebra or elementary statistics. Since, there have been quantitative research studies regarding students’ academic success while enrolled in a developmental math sequence (Ashby, Sadera, and McNary, 2011; Bachman, 2013; Howard & Whitaker, 2011; Reyes, 2010), this research explored how and why students who have completed the developmental math sequence were academically successful and persisted in college algebra or elementary statistics. Furthermore, the goal is to explore the influences that led the students to be academically successful in college algebra or elementary statistics after completion of the developmental math sequence.

Research Questions

How and why did students’ changes in behavior improve academic success in math courses and persistence at the community college level? The following research questions addressed the topic and directed the research:
**Research Question One:** How do community college students perceive their ability to perform successfully in college level math courses after completion of the developmental math sequence? The importance of this question is to hear the voices of the participants’ perception and description of achieving academic success. Eighty percent of all community college students who are placed in the developmental math sequence leave before attaining a certificate or diploma (Bahr, 2012a). In addition, the participants reflected on their successful journey through the developmental course and the success they experienced in college algebra or elementary statistics. Dweck (1996) stated that when students take ownership of their education and learning, they believe that with time, effort, and performance they can improve their academic achievement.

**Research Question Two:** How are successful community college students socially integrated on the community college campus? Tinto (1997) stated that students who persist through post-secondary education develop academic involvement and social integration. This question prompted the participants to look inward to the specific behaviors that encouraged them to continue in college level math courses after completing the developmental math sequence. Participants identified changes in their behavior that enabled them to be successful in the developmental math and college level math courses. Students who are socially connected to other students and faculty at the community college are more likely to remain enrolled and achieve academic success (Barnett, 2011; Deil-Amen, 2011; Tinto, 1997).

**Research Question Three:** What are the academic support programs that community college students describe as contributors to academic success and persistence in college level math courses? The emphasis on this question is to establish the academic support programs that influenced academic success and persistence. Mentoring, learning community programs,
tutoring services, and computerized software programs may provide community college students with the academic support programs they need to stay enrolled and achieve academic success (Crisp, 2010; Engstrom & Tinto, 2008; Halcrow & Iiams, 2011; & LaManque, 2009).

Research Plan

A qualitative case study was useful in exploring and understanding the influences that enabled academic success and persistence for community college math students. Stake (1995) described a case study as one that “seeks insight and greater understanding” (p. 16). The choice to use a case study design was due to Stake’s description and the internal nature of the research. A qualitative case study allows researchers to capture the holistic and significant descriptions of real-life events (Yin, 2009). This research was an instrumental case study; therefore, the research was guided by the phenomena and the case was secondary.

The boundaries of the case study included the case, phenomena, time, and location. The case was the community college students who completed the developmental math sequence and have completed college algebra or elementary statistics. The phenomena were the achievement of academic success and persistence of the community college student. The case was bound by the time and place. The time was after successful completion of the developmental math sequence while the place was at a community college.

Data collection consisted of archival data, surveys, interviews, field notes, and a focus group. Archival data consisted of the percentage of students who enrolled and completed the developmental math sequence and the percentage of students who enrolled in college level math courses after completing the developmental math sequence. These percentages added depth to the study and showed how the study’s participant population compared to other current literature. The learning support administrator from the community college where the research took place
retrieved this data. In addition, the learning support administrator generated a list of students who qualified as potential participants.

Participants completed a survey for demographic information. Interviews were the primary method for collecting data; follow up interviews were scheduled to clarify statements, confirm idioms, revisit themes, explore further responses, and ensure validity through members’ checks. A focus group was conducted to provide participants with an environment conducive to dialogue exchange. Data collected from individual interviews and the focus group session were transcribed and coded for similarities and differences, and then compared for emergent themes. Field notes were kept to document before and after interview data, facial expressions, body language, interviewer thoughts, dates, times, other expected and unexpected data. Archival data, surveys, interviews, focus groups, and field notes established multiple sources of data collecting.

Merriam (2009), Stake (1995), and Yin (2009) stated using multiple data sources ensure triangulation, credibility, and trustworthiness of the qualitative case study. During and after the data collection of this study, specific ethical considerations were taken. All data collected was kept in a locked storage container and a password protected computer. Pseudonyms were used for all participants and the community college where the research was conducted.

For the current research, the theoretical framework was based on the theory of persistence (Tinto, 1997; 1998) and the incremental theory of intelligence (Dweck, 1996; 2006). Students who are academically involved and socially integrated on their college campus are academically successful and persistent with their degree or certification (Barnett, 2011; Deil-Amen, 2011; Tinto, 1997; 1998). The incremental theory of intelligence suggested that students see themselves as in control of their successes and believe that through hard work and effort their
academic performance will be improved (Dweck, 1996; Khalkhali, 2012; Rattan, Good, & Dweck, 2011).

**Situation to Self**

As the primary researcher, my worldview looks through the lens of constructivism. The lens by which I view life’s occurrences are interpreted by the interactions I have with other individuals, the environment, and the world. Through this research, I focused on the participants’ historical and social perspective through their descriptions and perceptions of their math journey. I interpreted the meanings of the participants’ experiences and expressions during the interviews and the focus group (Creswell, 2007). I used the participants’ voice, dialog, and words to provide a rich, descriptive text of their own personal experience.

I am an active participant in my community as a teacher and stakeholder. As a high school Algebra I teacher, I am obligated to prepare students for the challenges and rigor of college courses; therefore, I perceive myself as a contributing partner in preparing students to engage and succeed in post-secondary education math courses. As a stakeholder in the community, it is my perception that the academic achievement of our community college students provides stability to the local businesses and economy.

**Delimitations and Limitations**

This qualitative case study was useful in understanding the influences that enabled academic success and persistence for community college math students. A qualitative case study allows researchers to explore and describe the holistic and significant accounts of real-life events (Yin, 2009).

Parameters of this bounded case study (Stake, 1995) were the selection of the participants’ math courses, participants’ age, location, and the decision to establish the grade of a
C or higher as academic success. The participants for this study were those who are currently enrolled at a community college, have successfully completed the developmental math sequence and college algebra or elementary statistics, and are between the traditional college ages of 18 to 24. The use of traditional aged students narrowed the case study by using a more defined group of participants (Bean & Metzer, 1985). Academic success in the developmental and college level math courses was limited to a grade of a C or higher (Crynes, 2013; Hoyt, 1999; & Reyes, 2010) because students who have received a grade lower than a C were at a much higher risk of dropping out of college (Crynes, 2013; Greene, Marti, & McClenny, 2008; Hoyt, 1999; & Reyes, 2010).

**Definitions**

The following terms need defining for the current research:

1. *College readiness* is a tool to assess if incoming freshmen students possess the skills and traits to be successful in the college (Shelton and Brown, 2010).

2. *Developmental math sequences* are programs designed to bridge the gap between students who are not ready and those who are ready for college level math courses (Parmer & Cutler, 2007).

3. *Remedial math course* is a course for students who are underprepared for college level math courses (Voge, 2008).

**Summary**

In chapter one, the following topics were discussed: the background, problem statement, significance of the study, research plan, research questions, situation to self, purpose statement, and delimitations. The background discussed the history of developmental math education. The problem statement summarized the main issue of community college students completing
developmental math and remaining academically successful and persistent in a college level math course. The significance of the study presented the intent of the research and identify the targeted audience. A description of the case study and how the research was conducted are discussed in the research plan. The research questions with supporting literature was identified. The researcher disclosed the motivation to conduct the study in the situation to self. The purpose statement provided an explanation of why the study needs to be conducted. Clear boundaries of the case study was presented in the delimitations section. Definitions were defined and cited using current literature.
CHAPTER TWO: LITERATURE REVIEW

Overview

In this chapter, the theoretical framework and an overview of the most current research linked to students’ success in mathematics after completion of the developmental math sequence are presented. Tinto’s theory of persistence and Dweck’s incremental theory of intelligence are discussed. In addition, this chapter offers an overview of the previous research with the findings and what the experts reveal about the students’ perception of their ability in math, alternatives to developmental math, different learning environments after being placed in or completing the developmental math sequence. The academic support programs and social supports available to community college students in the developmental math sequence are discussed. Furthermore, the placement tests that community colleges used to place students in the developmental math sequence are presented.

Theoretical Framework

Exploring how community college students who are placed in a developmental math course as freshmen achieved academic success in college level math courses and continued with their education established the need and exposed the gap in the literature for this study. There are gaps related to research conducted using specific grade levels of college students; the research studies focused on college freshmen, particularly in the first semester, and students who were currently enrolled in developmental math as the participants (Ashby, Sadera & McNary, 2011; Bahr, 2012a, 2012b; Bailey, 2009; Bailey et al., 2010; Crynes, 2013; Fike & Fike, 2012; Schweinle & Helming, 2010); however, little research has been done using students who began in the developmental math sequence and have completed at least one college level math course.
Quantitative studies have been conducted and the findings well documented concerning the growing numbers of community college freshmen who were placed in the developmental math sequence and the effects this has on persistence and graduation rates (Bahr, 2012a, 2012b; Bailey, 2009; Bailey, Jeong, & Cho, 2010; Koch, Slate, & Moore, 2012; Pascarella & Terenzini, 2005; Tinto, 1997; 1998). It has been found that students who do not complete the developmental math sequence are more likely to drop-out of college or choose a vocational certification that does not require math competency (Bahr, 2012a; Crynes, 2013; Engstrom & Tinto, 2008; Fike & Fike, 2012; Melguizo, Bos, & Prather, 2011). However, the research was lacking in regard to students’ specific behaviors and changes in behavior that improved success and persistence while they were enrolled in college level math courses.

Challenges that community college students face when placed in the developmental math sequence have been examined. These challenges consisted of the cost of developmental courses, struggling with a deficiency in math, and feelings of inadequacy (Bailey et al., 2009; Goldrick-Rab, 2010). The challenge to complete the developmental math sequence and remain in college is due to lack of support (Weiser & Riggio, 2009). Students who have strong support from family, friends, and teachers are more likely to succeed in the developmental math sequence (Weiser & Riggio, 2009). In addition, students who believe in their intrinsic ability to succeed at math have a greater possibility of succeeding in coursework and earning a college degree (Dweck, 1996; 2006; Schweinle & Helming, 2010; Zimmerman, Moylan, Hudesman, White, & Flugman, 2011).

Within this theoretical framework, Tinto’s (1997) theory of persistence and Dweck’s (1996) incremental theory of intelligence were discussed. The theoretical framework for this research was linked to existing theories and recent literature. Current research addressed the gap
that was used to justify the need for this qualitative case study. There was a need to conduct qualitative research to provide an opportunity for the community college students to voice their experiences of achieving academic success in college level math after completing the developmental math sequence; this study focused on the how and why community college students were academically successful and persisted in college level math courses after completing the developmental math sequence.

**Tinto: Theory of Persistence**

Tinto’s theory of persistence is connected to his integration framework of academic involvement and social integration. Tinto (1998) stated that in order for students to persist in their post-secondary education goals they must be academically involved and socially integrated with the community college. Usually, students who attend community colleges do not experience the residential involvement that four-year college students experience; students living in residential facilities have more opportunities for social integration (Tinto, 1997). Furthermore, community college students may be limited in the time they have to interact with other students and faculty; usually, involvement may be confined to the classroom (Tinto, 1998). However, Karp, Hughes, and O’Gara (2008) debunked the assumption that Tinto’s integration framework does not apply to community college students. The researchers affirmed that academic involvement and social integration are determinants to persistence of community college students. The researchers found that academic involvement and social integration are not separate; “the two forms of integration are developed simultaneously, through the same activities” (p. 18). They added that faculty members could play an integral role in planning activities that develop social integration within the classroom. In addition, classrooms that are designed to be student centered are more conducive to promote social integration and academic
involvement. Tinto’s theory of persistence is based on the students’ social and academic commitment to their community college experience. Tinto (1997) stated when students view the involvement as productive and feel that they are integrated into the community college experience they are more likely to persist. The theorist added that there is a correlation between social integration and academic persistence of college students.

On community college campuses, there are political, civic and religious organizations that provide social interaction outside of the classroom. Community college students must be proactive in becoming academically involved and socially integrated on the community college campus. Whether community college involvement and integration begin with organizations, sports, clubs, peer groups, faculty connections, study labs, or in the classrooms, researchers agreed that student’s academic involvement and social integration lead to academic success and persistence (Bahr, 2008, 2012a, 2012b; Bailey, 2009; Bailey et al., 2010; Koch, Slate, & Moore, 2012; Pascarella & Terenzini, 1980, 2005; Tinto, 1997; 1998).

Tinto (2006) found that faculty pedagogy is linked to student persistence. The manner in which an educator interacts with students, the atmosphere of the classroom, and the educator’s teaching styles affect students’ persistence and may determine the completion of a certificate or degree (Astin, 1999; Braxton, Brier, & Steele, 2008; Tinto, 2006). Pascarella and Terenzini’s (1980) study supported the predictive validity of Tinto’s model of persistence. The researchers agreed that students’ success and persistence relied heavily on the student and teacher’s relationship and the depth of the teacher’s concern for their student’s progress. The researchers added that the “quality and impact of student-faculty informal contacts may be as important as students’ institutional integration” (p. 72). In conclusion, they stated that the relationship between students and faculty is more important than the relationship between students and peers.
Similarly, Barnett (2011) proposed that when students are validated which means respected, recognized, and valued in the classroom by the instructor; then, they are more likely to experience academic success. The researcher studied how faculty validation influenced students to remain in the community college, thus realizing that for community college students integration is often restricted to the classroom. The researcher discovered that students’ perceptions of being valued and participating in a mentoring program provided stronger determinants for students to persist. Barnett (2011) concluded that faculty validation had a direct relationship to academic involvement and ultimately students’ persistence.

Another area that researchers have explored is student persistence; however, there are no clear solutions for the lack of persistence and retention (Astin, 1999; Pascarella & Terenzini, 2005; Tinto, 1997). Deil-Amen (2011) conducted a qualitative study to reinforce Tinto’s theory of persistence for community college students. The researcher found “mechanisms” that assisted students in persistence and retention by combining academics into their social domain, scheduling and planning efficiently, and establishing boundaries on external influences outside of academics (p. 81). Deil-Amen (2011) stated that “socio-academic integrative” events played an essential role in Tinto’s theory of persistence (p.81). The researcher explained:

The most common mechanisms were (a) a range of in-class interactions and dynamics, (b) formal or “spontaneous” study groups, (c) social-capital relevant interactions and mentor relationships with trusted faculty or other staff, (d) consistent access to communication with “similar” students (usually facilitated by some form of cohort scheduling that created consistency in the students that interacted with each other from one term to the next, and, to a lesser extent, (e) academically-relevant clubs and activities. (p. 81)
However, some researchers believe that student’s social integration must come before academic involvement while others believe that student’s academic involvement sparks integration beyond the classroom and into the social realm of college life (Deil-Amen, 2011; Engstrom & Tinto, 2008; Pascarella & Terenzini, 2005; Tinto, 1997). Hu (2010) described student persistence and student success as being synonymous; he added that student involvement is the bridge to student success. Students who are embedded and find a sense of belonging in their education tend to persist and stay enrolled in college. Furthermore, academic success and persistence in the developmental math sequence fostered a sense of belonging and strengthened the student’s intent to persist in the community college. Theorists and researchers agreed that students in the developmental math sequence need to be involved in academic support programs and social events to be successful and persistent in their college education (Barnett, 2011; Engstrom & Tinto, 2008; Hu, 2010; Pascarella & Terenzini, 2005; Tinto, 1997; 1998; 2006).

Kelly, LaVergne, Boone, and Boone (2012) studied students’ perceptions of social occurrences that would influence college persistence. Social integration provided students with the “stability and predictability” that are key components of student persistence (p. 654). Other components of student persistence are personal traits, prior experiences, and personal commitment. The researchers explained that the more connected the student is with the social aspects on campus the more likely the student will complete courses and graduate. The findings indicated that positive relationships with professors and positive experiences in required courses were influences that encourage students to persist.

Nonetheless, community colleges have not made significant gains in persistence and graduation rates (Meliguizo, Bos, & Prather, 2011). In a recent critical review of the literature, the researchers found contradiction in the effectiveness of the developmental math sequence on
students’ persistence at the community college level. Success is evident when a student progresses through the developmental math sequence in a timely manner while maintaining the knowledge and skills to be successful in college level math courses. The researchers found that students with the lowest skill levels in developmental math may transfer to a four year university; however, on average they spend five years at the community college and transfer only one year of credits. Consequently, students in the developmental math sequence are at risk of failing courses and dropping out of college. However, students who find academic success in the developmental math sequence persist and continue to college level math courses.

Bahr (2012b) examined the stages of the developmental math sequence in which students became unsuccessful and dropped out of the course. The researcher found that students who were placed in the developmental math sequence had various math skill levels. There was a disparity between the student with low skill levels and the student with high skill levels in the developmental math sequence. The researcher described five skill levels in the developmental math sequence that are below college level math courses. Students must follow a skill acquisition process to obtain necessary skills to become successful in each level of the developmental math sequence. In addition, Bahr (2012b) found a higher percent of students with lower skill levels did not pass the developmental math sequence and remain in college because of three characterizations: (a) nonspecific attrition, (b) skill-specific attrition, and (c) course-specific attrition. These characterizations are related to the student’s point of entry into the developmental math sequence and to each point of departure from the developmental math sequence. Participants made decisions and behavior changes in order to remain in the developmental math sequence and obtain competency skills to be successful in college level math courses. A key finding in this study conveyed that academically successful students with
low or high skill levels tend to seek assistance from academic support programs and social groups. With this in mind, these students became academically involved and socially integrated in the community college.

Hu (2010) studied how student success was directly related to student persistence and student engagement. The researcher emphasized the importance of well-planned, educational activities in and out of the classroom on students’ academic success. The researcher found that students with low levels of academic and social engagements were less likely to persist. On the contrary, students who possessed high levels of academic and social engagements were likely to persist. An interesting finding in this research was that students with low levels of academic engagement and high levels of social engagement were likely to persist. These findings support Tinto’s theory that social integration plays a vital role in student persistence.

Researchers have agreed that mentoring programs and learning communities are promoting student’s persistence and retention; however, these incentives address student affairs more than student academics (Astin, 1999; Engstrom & Tinto, 2008; Crisp, 2010; Halcrow & Iiams, 2011). While collegiate institutions are changing policies and implementing specialized programs to increase retention and graduation rates, community colleges must address the growing need for developmental courses (Tinto, 2006; Melguizo et al., 2011).

In the past 40 years, researchers have studied and suggested changes to improve students’ persistence and retention (Astin, 1999; Bean & Metzer, 1985; Tinto, 2006). There have been antidotes suggested for collegiate institutions to follow to increase retention and specific factors were given as to why college students are not persistent. For years, researchers have played the blame game; first to blame the colleges for not possessing the perfect program to keep students enrolled and then, to blame the students for being lazy, unmotivated, or inept (Braxton et al.,
Tinto (2006) listed factors of why students do not persist and remain enrolled in colleges; however, what we do not know is why some students stay, persist, and achieve academic success. The previous researchers have uncovered why students leave but not why they stay and how they become successful. The reason for student persistence and academic success is a gap in the literature and why the research needed to be conducted.

**Dweck: Implicit Theory of Intelligence: Incremental**

Dweck’s (1996) implicit theory of intelligence provided a foundation to the research and may be instrumental when the participants answer the interview questions regarding their perception of themselves and how they describe themselves as academically successful in math courses. In the incremental theory, intelligence is described as a malleable, controllable trait (Dweck, 1996). Students who feel they are in control of their mastery of learning and believe they can become academically successful in math possess traits of the incremental theory of intelligence. Students who have this trait believe that with time, effort, and performance, they can improve their academic success. Rattan, Good, and Dweck (2011) stated “Students’ implicit theory of intelligence and ability affects their motivation, learning, and achievement outcomes” (p. 731). The way in which students perceive themselves and their ability plays an integral part toward their goals, performances, and achievements. Students who believe they are in control of their successes are more willing and motivated to work harder and study more after experiencing an academic setback such as not being ready for college level math courses (Murphy & Dweck, 2010; Nussbaum & Dweck, 2008). In addition, Shively and Ryan (2013) examined “changes over time in implicit theories of intelligence and their relationships to help-seeking and academic performance” in a college algebra course (p. 241). The researchers found that students with traits of incremental theory of intelligence at the beginning of the college algebra course had
greater success at the end of the course than students who did not possess characteristics of the incremental theory. Furthermore, the researchers noted that students with incremental theory traits will meet the challenge head on by studying more effectively and asking for assistance such as tutoring and mentoring (Dweck, 2006b).

**Related Literature**

**Students’ Perceptions**

Current research focused on students’ perceptions of their ability while enrolled in the developmental math sequence at community colleges (Bachman, 2013; Deil-Amen, 2011; Howard & Whitaker, 2011; Koch, Slate, & Moore, 2012; Schweinle & Helming, 2010; Zimmerman et al., 2011). Bachman (2013) focused on the “shifts in student attitudes toward a more positive outlook on remediation and four influences impacting those shifts” (p. 14). The researcher examined the students’ experiences, perceptions, beliefs, and feelings while enrolled in the developmental math sequence. Seven of the nine participants expressed a negative perception of math remediation in the beginning of the coursework; they described their feelings of embarrassment, inadequacy, and unintelligence. However, all nine of the participants’ perception changed to a more positive view regarding the nature of the developmental math sequence and their ability by the end of the course. There was a shift in the participants’ understanding of the importance of math, of their ability to be successful, and of various academic support programs designed to improve success. As a result, a theme that emerged was the need to establish an academic relationship with the developmental math instructor. The researchers concluded that participants were more successful in the developmental math sequence if they felt a connection to the teacher; furthermore, a relationship was more likely if the teacher was caring, attentive, and believed that the student could be successful. Students’
perception of their ability to be successful is connected to the relationships formed on the college campus. Therefore, the findings of this study conveyed that social integration is grounded in the academic success of community college students.

Similarly, Deil-Amen (2011) found that educators were valuable resources for students’ success and persistence. The researcher stated that students’ interaction with the faculty was a more important relationship than a relationship with a peer, counselor, or an advisor. Students who experienced positive academic interactions with their teacher were more successful and more likely to graduate. The results of this study indicate the importance of social interaction on students’ academic success and persistence in the community college.

Howard and Whitaker (2011) focused on the students’ perceptions and experiences while transitioning from being an unsuccessful math student to having success as a math student while enrolled in the developmental math sequence. The findings revealed that successful students in the developmental math sequence utilized effective learning strategies such as individual tutoring, study groups, and structured mathematic labs. However, these strategies were not enough; the participants had to change their perceptions of themselves as being in control of their learning and; ultimately, their academic success. The students’ perception of how to be successful derived from their own performance in the developmental math class (Howard & Whitaker, 2011). As participants were asked about the difference between being unsuccessful and successful, the key theme that continued to emerge was student involvement with professors. The participants expressed how their families, peers, and other school resources such as mathematic labs and tutors helped in the motivation to persist and complete the developmental math sequence. With the help and influence of their professors, the participants were motivated to be academically involved and socially integrated in their educational experience. Howard and
Whitaker (2011) added the participants’ belief in the importance of mathematics, their perceptual changes in their ability, and the utilization of learning strategies reshaped their ability to be successful in math. The findings of this study revealed how students with confidence and determination are more eager to engage in learning strategies, tutoring services, and mentoring programs. Therefore, students who perceive their ability in a positive, productive way share traits of the incremental theory of intelligence (Dweck, 2006b).

In another qualitative study, Koch et al., (2012) stated their purpose was to “examine student’s perceptions about the effect of developmental programs on their academic skills and the role of these programs in helping the students to meet their long-term educational goals” (p. 71). As the participants completed portions of the developmental math sequence, they achieved a sense of self-worth through their academic success. The researchers documented three positive themes regarding the participants’ experience in the developmental math sequence. One theme was the increased level of confidence that participants achieved as they became better math students. Motivation was another theme that the participants experienced as their math ability strengthened. Lastly, a positive theme that emerged was how the participants became aware “of their individual learning styles and were able to articulate preferences for particular instructional activities that aligned to their learning styles” (p. 76). The participants revealed optimistic attitudes regarding “affective perceptions, academic perceptions, behavior, and routines” (p. 73). The participants stated they gained confidence in their math skills as they understood the importance of math in real world problems and experienced success with the help of caring professors and supportive resources. The findings of this study reinforced that students can impact their college math success by developing academic relationships with professors and participating in academic support programs.
In a similar study, Zavarella and Ignash (2009) examined the learning styles of students and their choice of developmental math delivery. Three delivery methods were studied: traditional, hybrid, which is a blended class of traditional and online, and the distance learning or online class. The Grasha-Riechmann Student Learning Style Scale (GRSLSS) was used and identified six learning styles; “competitive, collaborative, avoidant, participant, dependent, and independent” (p. 4). Students who possessed the collaborative and participant learning styles were prevalent in all three learning environments. Students with a collaborative learning style were cooperative with the teacher and peers; they liked to share and learn information. The participant learners enjoyed learning; they were engaged in class and completed the assignments. The researchers found that students who were active in their learning and perceived in their ability to succeed were likely to successfully complete the developmental math sequence. The findings suggest that students’ perception of their ability to perform is related to the students’ academic success and level of persistence.

Roberts and Styron (2010) examined college students’ perception of supports, relationships, and experiences. The researchers found two key influences of student persistence and academic success: “social connectedness and satisfaction with faculty approachability” (p.1). Social connectedness has various degrees of connectedness from student to student but all students benefit from being connected to other students that share common goals. These important goals are to achieve academic success in coursework and persist to graduation. For students to bond with each other there should be a level of security and with this security forms a social connectedness. The other key influence was satisfaction with faculty approachability. Student and faculty relationships are vital to the student’s academic success and persistence. The manner in which a faculty member interacts with students projects the approachability factor.
Professors who make themselves available and interact with students outside of the classroom possess approachability. The better the relationship between student and faculty the better the opportunity the student has with successful completion of coursework and graduation.

Schweinle and Helming (2010) explored the motivating influences of why college students succeed or fail at challenging activities and how students perceive success or failure of challenging activities. The researchers noted that students performed better with challenging activities or tasks that were formal and structured instead of informal and unorganized. Success was related to the students’ goals, self-efficacy, engagement, and intrinsic values; however, students devalued the activities that they perceived themselves as being less skilled in or too inadequate to master. These findings may explain why students who were faced with the difficult challenge of completing the developmental math sequence succeeded and continue academic success in college level courses.

Zimmerman et al. (2011) indicated how college students achieved academic math success through self-reflection. The research implemented a three phase self-reflection training for teachers and students. One important component in the instructor’s training was to measure and instill self-efficacy beliefs in the students. Moreover, participants in the self-regulated learning (SRL) group applied self-reflection techniques when solving math problems on quizzes and when instructors provided immediate feedback on errors. This study’s findings showed how students who believed in themselves, their ability to achieve academic success, and who perceived their instructor as truly interested in their math achievement demonstrated traits of the incremental theory.
Differences in Developmental Math Sequences

Each year community colleges make changes to the developmental math program to provide better instruction, ensure success and improve persistence of the students who are placed in the developmental math sequence (Bailey, et al., 2010; Crynes, 2013; Fike & Fike, 2012; Parmer & Cutler, 2007; Reyes, 2010; Rodgers, Posler, & Trible, 2012). Individualized placements, interventions, condensed courses, computer assisted instruction, and combined math courses are described as changes to the traditional, full semester developmental math sequence. Using data from a longitudinal study conducted in Tennessee, Boatman and Long (2010) examined the “impact of remediation on students with more severe levels of unpreparedness” (p. 1). The researchers found significant negative effects for students with a higher math ability level who were placed in developmental math; students who possess lower ability levels were placed in the lower developmental math sequence with marginal negative effects. Students with higher ability levels and who were placed in the developmental math sequence earned fewer credits than their peers who were placed in the first college level math course. The researchers suggested that the developmental math sequence was not beneficial to all students and should be considered as an intervention and individualized to each student with regards to the impact that the placement will have on the student. However, Bettinger et al., (2013) found that students who were placed in the higher skill level developmental math sequence were more likely to be successful and progress into college level math courses because of the shortened length of time spent in the developmental math sequence. The researchers explained that one goal of the community college was to shorten the time that students spend in the developmental math sequence. This reduced time spent in developmental math may have a positive impact on students’ perception of their ability to succeed and persist. The researchers discussed how
community colleges have redesigned the developmental math sequence to speed up the time students spend in the sequence. This redesign included implementation of academic support programs such as learning communities, summer bridge courses, and mentoring services. The findings indicated that students who are actively involved in academic support programs and are socially integrated are more likely to complete the developmental math sequence and enroll in college level math courses.

Fike and Fike (2012) conducted a study to assess the impact of participation in a developmental math sequence on the student’s academic success and persistence. The researchers investigated the “student’s academic preparedness” and the effectiveness of the developmental math sequence. The researchers conducted a quantitative study that allowed students to enroll in other coursework while delaying enrollment into the developmental math sequence. The study reiterated the statistical data regarding the increasing number of students who were not college ready after high school graduation; 62% of incoming freshmen were placed in the developmental math sequence. Fike and Fike (2012) stated the “overabundance of students needing the developmental math sequence places a burden on the students and the post-secondary institutions” (p. 2). The researchers challenged whether or not students should be required to take developmental math in their first semester or be allowed to take it later. Revealing the magnitude of the study, the researchers began with 3,476 students; 884 were college ready and 2,592 were in need of the developmental math sequence. Of the students who needed developmental math, 1,139 enrolled in developmental math during their first semester while 1,453 deferred enrollment until after their first semester. After the first semester, the researchers ranked the students from highest to lowest. The findings revealed that the students who took developmental math and passed with a grade of a C or above were ranked equal to the
college ready students; next, students who deferred enrollment placed second while students who took but failed the developmental math course were ranked the lowest. Of the students who took developmental math during their first semester, 71% passed the course. All developmental math programs vary from institution to institution; however, the developmental programs were designed with one mission in mind and that was to prepare students for college level courses (Fike & Fike, 2012). The researchers concluded that allowing students who need developmental math to delay enrollment may not be a good decision. The researchers found that students who were successful in the developmental math sequence accredited their success to interventions such as tutoring, mentoring, and study groups. As this study revealed, students who were academically involved in assistance programs while enrolled in the developmental math sequence were more likely to be successful in college level math courses.

Another concern discussed in the literature is high attrition rates. Community college students who did not possess college readiness skills have been faced with barriers that are too massive to overcome; therefore, they have chosen to leave college before completing the sequences in the developmental education courses. Bailey et al., (2010) analyzed the structure of the developmental math sequence and recommended that colleges provide a shortcut for students who need developmental classes, hoping to reduce the number of dropouts. One shortcut described was to allow students to enter into college level courses while working to complete the developmental sequence. Another shortcut was to allow the students who placed in the developmental math sequence to take a “gatekeeper” course, which is the lowest college level course (p. 261). If the students passed the “gatekeeper” course then they bypassed the developmental math sequence completely. The researchers found two-thirds of all community college students were placed in one or more of the developmental education courses, which is
consistent with other research statistics of the number of students who are not prepared for college level courses (Bahr, 2012b; Butcher & Visher, 2013; Fain, 2012). The findings of this research conveyed that students who could bypass the developmental math sequence and enroll in a college level math course were more likely to persist in the community college.

On the contrary, Rodgers et al., (2012) examined “Rapid Review,” an initiative to speed up the time students spend in developmental courses without lowering the university’s academic values (p. 252). The participants enrolled in a self-paced developmental math course; the participants were expected to complete the course in a timely manner and save themselves a semester of developmental math (Rodgers et al., 2012). This type of math program allowed the students to accept ownership of their education, specifically, their math education. The researchers indicated that the implementation of an intensive three-week math review can replace a semester course with significant success. The researchers stated, “It is possible to implement rigorous, intensive programs that can be effective at decreasing the length of time students spend in developmental mathematics courses without lowering academic expectations” (p. 260). As this study revealed, students who were actively involved in the academic process, assumed ownership of their success, and met the challenges of developmental math were more likely to be successful in college level courses and remain in college.

In another quantitative study, Crynes (2013) studied the validity and use of placement tests to enroll a student into a higher developmental math sequence. The researcher suggested that academic advisors should look at the students’ placement test scores and grade point average then bump the students’ placement one or two courses higher. Crynes (2013) called this change of placement “forward placement” (p. 4). The researcher explained that the problem was with the different placement tests resulting in contradictory scores for the student. In the study, there
were four groups of participants; (a) forward-placed students, who placed at entry level yet enrolled in the second level math course; (b) declined students, who scored at entry level and stayed at entry level; (c) entry-level students, who were a control group at the entry level math course; (d) second-level students, who were a control group at the second-level math course. Participants were placed in groups based upon their ACT math scores and the COMPASS math scores. Students who were placed forward in math courses benefitted by freeing up a course so another course could be substituted. However, there was no statistical significance in final grade distribution or grade point averages for the forward placement students. When given the opportunity to forward place in math courses, more students chose to be forward placed (Crynes, 2013). Success in one college level math class increased the students’ confidence level to be successful in a second math course. The researcher noted that the two tests placement method provided students with a more accurate assessment of their math skills and eligibility into a specific math course. Furthermore, the findings suggested that the accuracy of the two tests placement method strengthened the students’ perception of their ability to perform and succeed.

**Predictors of Academic Success**

Researchers have studied internal and external influences that predict success of college math students (Dasinger, 2013; Weiser & Riggio, 2009; Wolfle, 2012). Internal influences consisted of ability, drive, and performance while external influences consisted of family, friends, academic assistance and social groups. Dasinger (2013) determined the attribution styles of traditional and non-traditional students in a developmental math class. Individuals who were successful attribute it to ability and hard work, while those who fail at a task attribute it to lack of ability (Dasinger, 2013). Causal attribution theory is a study of an individual’s reasoning for being successful or unsuccessful. Often, students who succeed accredit it to internal influences
such as effort and talent, while students who fail accredit it to external influences such as environment and assignments. The researcher’s findings revealed that the moderately nontraditional aged 26-30 year old and highly nontraditional aged 31-59 year old students were more successful and scored higher on exams than the traditional aged students. They attributed their success to personal or internal traits. Regardless of age, students who believe that they can be successful through hard work and determination usually are successful. The findings of this study are linked to Dweck’s (2006b) incremental theory of intelligence; academically successful students accredited their success to learning, growing, and performing.

Weiser and Riggio (2009) focused on whether “self-efficacy mediates the relationship between family background and academic achievement” (p. 367). The researchers measured the effect of numerous family behaviors used to predict academic outcomes. The family behaviors included “parent participation in school activities, communication between parent and child regarding school, assistance with homework, and supervision and monitoring of schoolwork” (p. 368). The findings were only partially supported, which lead the researchers to conclude that self-efficacy enhanced in the classroom could be directly linked to greater academic achievement even more so than family support. In contrast, the researchers added that family circumstances could negatively affect the student’s academic achievement. While family and friends’ involvement and support are important influences in encouraging student persistence and academic success, self-efficacy interventions in the classroom can do more to raise student’s academic outcomes. Students’ perception of their ability may be formed by internal influences such as drive, self-esteem, and intelligence. At the same time, students’ perception of ability may be formed by external influences such as tutoring services, mentoring, faculty relationships, friends and family supports, and the use of the math lab.
Wolfle (2012) examined if age or ethnicity combined influenced persistence rates to the second year and the academic success of students in their first college level math course. The researcher stated that of the students who enrolled in the developmental math sequence, the community college’s developmental education program successfully raised the academic level of their students to college ready level regardless of age or ethnicity. There were no significant differences between age and ethnicity in students’ persistence rates. The researcher added that when given a choice to enroll in a developmental math program, students who enrolled in the developmental math sequence were successful; however, there were many students who did not enroll in the needed development math sequence. The key findings of this study provided support to Dweck’s incremental theory of intelligence by stating that students’ perception of their ability to perform influenced the academic success in the developmental math sequence and college level math courses.

Bremer, Center, Opsal, Medhanie, Jang, and Geise, (2013) found that after taking the developmental math sequence students who were seeking an occupational degree had a higher grade point average and were more likely to graduate. Furthermore, students who were enrolled in the developmental math sequence during their first semester were more successful and had higher retention rates in their second year at the community college. The researchers stated that internal influences such as focus and determination played a role in students’ success and persistence into the second year of college. The students’ internal influences are directly correlated to the traits of Dweck’s incremental theory of intelligence and are instrumental in students’ achieving academic success and continuing persistence in community college.
Challenges of Success and Persistence

Even with academic supports programs and social integration, community college students who were placed in the developmental math sequence were faced with challenging tasks of completing the course and graduating (Bisk, 2013; Jones, Price, & Randall, 2011).

Bisk (2013) discussed the successes achieved in the developmental math sequence at a state college. The college raised the success rate in the developmental math program by 50% primarily through awareness activities. The researcher explained “by providing clear and consistent standards as well as a nurturing, supportive environment” their students experienced success (“Why are Teachers Unprepared” para. 8). External influences supplied students with the support they needed to become successful in developmental and college level math courses. The intensive work done at this college has lowered the number of courses in the developmental math sequence needed for students who are not ready for college level math courses; however, they have not lowered the skills, knowledge, and standards needed to be competitive in today’s society. The findings reinforced the premise that successful math students should be academically involved and socially integrated at the community college.

Jones et al., (2011) conducted a study to identify math deficiencies among college students and to determine whether or not these deficiencies influence grades. The researchers found that college students are lacking in basic math skills such as order of operations, adding or subtracting fractions, and percent conversations. The deficiency of these basic math skills impacted students’ grades and the ability to progress into college level math courses. The researchers believed that lacking in basic math skills prevented individuals from thinking analytically, using logic, and interpreting data. “Lack of skills and fear of math contribute to the high dropout rates colleges experience in math and math-based classes” (p. 387). As a result of
this study, it is important for students to assume an active role in the building of their math knowledge and become socially connected on the community college campus. Tinto (2006) believed that students must be academically and socially connected to the community college.

**Social Supports for Math Students**

Community colleges used different strategies to assist students who were placed in the developmental math sequence; therefore, college institutions developed support strategies specifically for those students (Boroch et al., 2007). Mentoring, learning communities, tutoring services, academic coaching, and computerized software programs provided community college students with the support they needed to stay enrolled and achieve academic success (Boroch et al., 2007; Crisp, 2010; Engstrom & Tinto, 2008; Halcrow & Iiams, 2011; Hooker, 2011). In a literature review, Boroch et al., (2007) indicated how instructional practices and academic support initiatives were “characteristic of highly effective developmental education programs” (p. 83). Small peer led groups proved to be beneficial supports to students in developmental math classes. Similarly, Hooker (2011) studied how collaborative learning groups influenced the success and graduation of students who placed and struggled in the developmental math sequence. Students who enrolled in a developmental pre-algebra class were divided into two groups; a treatment group and control group. The treatment group was comprised of three or four students with a group leader; the group leader encouraged the group to use vocabulary and math concepts, solve real-life math problems, think collaboratively about mathematical problems, and learn to work together in a group setting. Through surveys and interviews, the researcher found that students who participated in group work achieved higher grades. The researcher described the group work as collaborative work sessions and hands-on activities. Within the group work setting, the students spent time explaining their work to their peers and
developing trust. The control group experienced a more traditional classroom setting with lecturing as the primary mode of instruction. The findings concluded that the treatment group had a 43% completion rate while the control group had a 35% completion rate; furthermore, seven students in the treatment groups earned an A, while only two earned an A in the control group. An unexpected result of the study was that the group leaders experienced higher self-esteem, self-confidence, and more personal growth due to the interactions with the group members. The premise of Hooker’s study was that hands-on activities, meaningful real-life problems, and caring, supportive instructors provided the necessary supports to spark students’ interest and strengthen students’ ability level in developmental math. This study showed how academic support programs provide the necessary support to ensure academic success and successful students complete courses and persist in college.

Another academic support that connects students with encouraging faculty is academic coaching. Academic coaching, a support that has experienced success with students in the developmental math sequence, provided students with an advisor who maintained contact and developed a more personal relationship with the student (Bettinger et al., 2013). The researchers stated that some colleges provided a monetary incentive for students to meet with advisors and cultivate a relationship with their advisors. Due to its brevity, the findings were inconclusive as to whether academic coaching provided students with the necessary support to be successful and persist in college. However, the researchers speculated that academic coaching would benefit students in making connections and interacting with college faculty on campus, if given more time to cultivate this type support approach. The research findings yield to the theory of persistence; students who are have a healthy, productive relationship with a professor are more likely to successful complete the course and persist in college (Tinto, 2006).
Students in the developmental math sequence must find the right academic strategy to improve their success; likewise, it is crucial for colleges to offer support to their struggling students (Crisp, 2010; Engstrom & Tinto, 2008; Halcrow & Iiams, 2011). Mentoring programs were designed to give support to college students throughout their college experience in order to achieve academic success and build relationships between the mentor and mentee (Crisp, 2010). Mentoring can be formal or informal relationships occurring between faculty, staff, students, families, upper classmen, club and/or religious leaders. Mentoring programs included but are not limited to psychological, academic, social, degree completion, religious, and/or role model support. The researcher stated that mentoring programs contributed to persistence and offered academic and social supports to community college students by providing a means to be connected to the college’s faculty. The nature and implementation of mentoring programs ensured persistence in attaining a certification or completion of a degree (Crisp, 2010; Tinto, 1997).

In addition, learning community projects were designed by community colleges to link students and faculty together in specific courses. Within the learning community, students developed their own support group; therefore, the environment was more conducive to build an academic network between peers and professors (Engstrom & Tinto, 2008; Tinto, 1998). The idea was for learning to flow from one course to another with the same group of students in order to build relationships within classrooms and target courses that students tend to struggle with the most. Engstrom and Tinto (2008) explained how learning community projects provided support services in the form of a guidance and counseling course, established relationships among faculty and students, and were designed for students to collaborate several times a day with the same peers and in the same classroom. After experiencing the learning communities, students felt
more connected to their peers, professors, and educational curriculum; therefore, they perceived themselves as having more academic and social supports. The researchers found learning communities to be highly successful for college students who began in developmental courses. Community college students who were involved in the learning communities, classroom activities, and social events on the college’s campus were more likely to persist and complete their degree or certification. The researchers noted that some learning communities have become alternatives to the developmental education courses. Alternatives to developmental education have been sought after due to cost efficiency for the college and the student; in addition, students who placed in the developmental math sequence were isolated and often marginalized into courses where no credit was given and financial aid did not cover the expense. The findings suggested that academic involvement and social integration are part of a learning community and these supports lead to persistence.

Jackson, Stebleton, and Laanan (2013) examined learning communities from the professor’s perspective. The researchers found that professors gained “greater empathy for and awareness of students and the development of authentic relationships with students” (p. 3). The professors claimed that they became more aware of the students’ learning needs; equally, they developed an interest in knowing the students on a personal level. The researchers concluded by stating, “Faculty members can play key roles in the challenge to engage and retain community college students” (p. 19). Learning communities were designed to improve student academic success and persistence by staging environments and individuals to initiate involvement and relationships.

Gallard et al. (2010) studied retention rates and success in the developmental math sequence through tutoring services that were provided by trained, experienced tutors. The
researchers found that students needed assistance in advancing through their college coursework. Early successful intervention is essential for students who struggled in math and were placed in the developmental math sequence. The researchers concluded that if students in the developmental math sequence did not succeed then they would not likely be successful in any other area of community college. The researchers suggested that tutoring services combined social integration and academic support to community college students.

Halcrow and Iiams (2011) examined the difference between course grades in four freshmen level mathematics’ courses. Students who attended the learning center for studying purposes, collaborating with study groups, or receiving tutoring services were found to have a higher level of confidence in math, better grades in math courses, and improved study habits. The researchers discussed the mechanics of a Mathematics Learning Center (MLC) and how students used the tutoring facility. Students spent more time in the tutoring facility; moreover, students expressed how enjoyable and meaningful it was to study with others. The findings revealed that there was a correlation between time spent in the MLC, completion rates, perception of ability, and academic achievement.

Community colleges offered successful tutoring services to struggling students across various content areas, particularly developmental math. Bremer et al. (2013) found that community college students who took advantage of tutoring services during their developmental math sequence had better retention rates, higher grade point averages, and higher grade point averages in non-developmental courses in their second year of college.

**Academic Support Programs for Math Students**

Developmental math programs are designed to “bridge the gap” between students who are not ready and those who are ready for college level math courses (Parmer & Cutler, 2007, p.
Two- and four-year colleges provided remediation for the students who were placed in the developmental math sequence by utilizing academic support programs; these programs were ever-changing to become more productive and cost efficient. Community colleges explored specific academic support programs to offer to students in the developmental math sequence (Butcher & Visher, 2013; LaManque, 2009; Mireles, Offer, Ward, & Dohen, 2011; Silverman & Seidman, 2012).

An academic support program designed as an “innovative homegrown intervention” was the Beacon Mentoring Program (Butcher & Visher, 2013, p. 313). This program took the college’s tutoring and mentoring information into the classroom instead of waiting for students to seek out help or services. The researchers studied the effects of the Beacon Mentoring Program on the use of tutoring services, math class withdrawal, completion rates, enrollment for the subsequent semester, and part-time versus full-time students. “The Beacon Mentoring Program was implemented to address a problem that faces the majority of U.S. community colleges: high failure rates in remedial and gatekeeper math courses” (p. 313). The program delivered information regarding tutoring services and other academic supports directly into the classrooms to students instead of students inquiring about services on their own. The Beacon Mentoring Program increased the number of students taking advantage of the tutoring services by 30% and decreased the withdrawal rate by 20%. The part-time students, who were at a higher risk of dropping out, seemed to benefit from the program more than the full-time students. The program significantly improved the math class retention and passing rates for part-time students. The findings showed how an academic support program can empower students to persist and achieve success.
In another study, utilizing the EnableMath program was a strategy to improve math success among students who were placed in basic skill courses or the developmental math sequence. LaManque (2009) discussed EnableMath, a computerized math software program used to improve developmental math success rates by allowing students to solve math problems in the computer lab. Success was measured by students completing the first course then progressing to the second course of the sequence in a timely manner. The researcher could not differentiate if the success derived from the interventions or the educator’s instruction. However, students who received interventions in the first and second developmental math courses were more successful than students who only received interventions in the first developmental math course. LaManque (2009) believed that this was because the interventions were not embedded in the first course and did not become established as second nature to the way students learn and study. The findings of this study relate to how academic success is tied to academic support programs and social integration with the faculty.

Mireles et al. (2011) studied the effectiveness of study strategies in the math Fundamentals of Conceptual Understanding and Success (FOCUS) program. FOCUS was a summer intensive program that combined developmental math and college algebra courses. The program emphasized two methods: supplemental instruction and learning strategy instruction; both of these methods created a classroom environment that was conducive to learning and established relationships with peers and professors. Collaboration and cohesion were encouraged and demonstrated during the FOCUS program. The researchers voiced a major concern: “An indication that developmental mathematics is a stumbling block in the path for graduation is the fact that many students take developmental mathematics courses many times before passing the course if at all” (p. 12). The researchers found an interesting aspect of the 47
participants less than half completed the course while 12 were repeating the program. However, the findings revealed the program to be successful in the implementation of study and learning strategies that are specific to the needs of students in the developmental math sequence. The researchers showed how social relationships can be made while in an academic setting. Also, the findings connect the idea that the students who are involved in academic support programs experience academic success and persistence.

The Math My Way (MMW) program, a hands-on series of self-paced math learning modules, provided students the opportunity to work at their own pace with other students who possessed similar skill levels. Silverman and Seidman (2012) examined whether the MMW program “improved progression rates and academic achievement” in developmental math (p. 267). MMW was “developed to integrate module-based curriculum and mastery learning approaches” (p. 267). The researchers stated that early detection of math areas where students needed to strengthen and continual, consistent interventions would improve students’ success and retention rate. The researchers’ findings indicated that self-paced, academic support programs improve students’ academic success and persistence rate.

**Placement of Students in Developmental Math**

Community colleges utilized college readiness assessments to measure how well prepared students are for college level courses; then, the assessments are used to determine developmental or college level course placement for the students. College readiness has a multifaceted definition of academic and non-academic traits. Work ethics, family support, personality, maturity level, test scores, grade point average, and student transcripts have been used as indicators of college readiness (Porter & Polikoff, 2011; Shelton & Brown, 2010). National Assessment of Educational Progress (NAEP), ACCUPLACER, and ACT Computer-
adaptive Placement Assessment and Support System (COMPASS) are college placement tests that measure academic college preparedness (Crynes, 2013). The National Assessment of Educational Progress (NAEP) is an organization that provides assessments in “mathematics, reading, science, writing, the arts, civics, economics, geography, U.S. history, and beginning in 2014, in Technology and Engineering Literacy (TEL)” to America’s students (NCES, 2012). NAEP is governed by the U.S. Department of Education and provides students’ achievement comparisons across the states. The ACCUPLACER is a computer-adaptive test that assesses strengths and weaknesses in math, reading, and writing; it is used as a college placement assessment (College Board, 2009). In 1996, the organization known as the American College Testing changed its name to ACT (ACT, 2007). The ACT COMPASS mathematics test provides placement tests in up to five subject areas; it is designed to assist students’ placement in appropriate math courses in post-secondary education (ACT COMPASS, 2007).

These college placement tests are problematic due to no universal cut scores, the vast number of different placement tests used by colleges, and the validity of the tests (Crynes, 2013; Goeller, 2013; Porter & Polikoff, 2011). There are more than 100 placement tests used in colleges in the Southeast (Porter & Polikoff, 2011). One aspect of ensuring accuracy of placement tests is to align the placement test items with the state standards for high school math courses (Shelton & Brown, 2010). The Common Core Standards Initiative (2010), sponsored by the National Governors Association, the Council of Chief State School Officers, and Achieve, will be implementing new standards within the next three years. It is still unclear which college readiness test will be endorsed; however, it is speculated that other countries’ benchmarks will impact America’s college readiness benchmarks (Porter & Polikoff, 2011).
Summary

Students need a way to connect the learning to real-life situations. Individuals believe that math is simply memorization of rules and concepts; others believe it is the process of problem solving (Schoenfeld, 2009). The way individuals think of or view math could be from a lived experience in an earlier math class. Math is more than getting an answer; it is a way to think and process information (Schoenfeld, 2009). College students in the developmental math sequence need to make sense of the learning and why it is necessary to complete the sequence of courses (Howard & Whitaker, 2011; Schoenfeld, 2009).

Community college students must be successful and persist in math courses to pursue their educational goals of earning a degree. Students’ academic and social connectedness are closely related to their success and persistence in math courses. The high volume of community college freshmen who are not ready for college level courses is evident throughout the literature. Influences that help or hinder students’ success and persistence, students’ perceptions of their placement in developmental math, support strategies that lend some assistance to struggling students, and academic support programs that are productive for community college students have been researched (e.g., Bachman, 2013; Butcher & Visher, 2013; Dasinger, 2013; Hooker, 2011; Rodger et al., 2011). Quantitative studies discussed the high percentage of students who are placed in the developmental math sequence and the researchers pointed out that more than half of those students do not pass the courses or earn a degree or certificate (e.g., Bahr, 2012a, 2012b; Bailey, 2009; Bailey et al., 2010; Pascarella & Terenzini, 2005; Tinto, 1997, 1998). Qualitative studies concentrated on freshmen students who were placed in the developmental math sequence (Bachman, 2013; Howard & Whitaker, 2011; Koch et al., 2012). Other qualitative research focused on the perceptions of the students as they succeeded or failed in the
developmental math sequence (Zimmerman et al., 2011). Students expressed that the teachers and staff have been valuable to their academic success and persistence in the community college. Quantitative studies have targeted academic success and persistence of community college students. However, there have been few qualitative studies that addressed the individual student and answered how and why some students achieve academic success and earn a degree. Awareness of the problem is wide spread. Solutions to correct or reduce the number of students who are underprepared for the community college, students who quit college before earning a certificate or degree, or students who cannot achieve academic success in the developmental math sequence are unclear. There have been few qualitative studies conducted to explore the phenomenon of how students achieve academic success and persistence in a community college after completion of the developmental math sequence (e.g., Bachman, 2013; Howard & Whitaker, 2011; Koch et al., 2012). The current research provided insight regarding how students can achieve academic success after completing the developmental math sequence. The current research addressed the gap in the literature regarding the lack of qualitative studies conducted with community college students who have achieved academic success and persistence in developmental math and college algebra or elementary statistics. This research gave those students a voice to share their perceptions and experiences as successful math students.
CHAPTER THREE: METHODS

Overview

Within this chapter, a generalized introduction and the methodology of the research study are provided and a detailed presentation of procedures and specific components of the research design are supplied to enable replication of the case study in the future. In addition, analysis of the data collection and implications for trustworthiness and ethical considerations are described for the research study. A brief overview, recent changes, and pertinent information regarding the Tennessee Board of Regents and Tennessee’s community colleges were provided.

This qualitative case study was designed to explore the how and why changes in students’ behavior improved academic success in their college level math courses at the community college after completing the developmental math sequence. Permission from Liberty University’s Institutional Review Board (IRB), the community college where the research was conducted, and informed consent from all participants were obtained. A survey was given for collecting demographic information. Interviews were conducted with individual participants in a one-on-one fashion using audio and video media as permitted. Interview data was transcribed and analyzed with follow up interviews to ensure accuracy and validity. A focus group was scheduled to promote conversation and a more comfortable dialog between participants regarding their journey into developmental math and college level math courses. The focus group session was arranged after the individual interviews so that additional information could be obtained. Archival data and statistical data from the community college such as the percentage of students enrolling in the developmental math sequence, retention rate, and degree completion rate were collected and analyzed. Emerging themes were defined once the data are collected and analyzed.
Design

This qualitative case study was useful in exploring the influences that enabled academic success and persistence for community college math students. A case study was suitable for gaining insight and understanding of how and why some college students were successful in college level math courses after completing the developmental math sequence (Stake, 1995). A qualitative case study allows researchers to capture the holistic and significant descriptions of real-life events (Yin, 2009). This research was an instrumental case study; therefore, the research was guided by the phenomena and the case was secondary. Stake (1995) stated the use of the case study was to understand something else; the case study was used to understand how and why some community college students were successful in college algebra or elementary statistics after completion of the developmental math sequence. Therefore, the phenomena were how and why some community college students succeed and persist in college level math courses after completion of the developmental math sequence. The case was bound by time and place. The time was considered as after successful completion of the developmental math sequence and the place was at the community college. Academic success in the developmental math sequence and college algebra or elementary statistics was limited to a grade of a C or higher (Crynes, 2013; Hoyt, 1999; & Reyes, 2010).

Once Liberty University’s IRB and the president of the community college where the research took place gave permission to conduct the research study, data collection began. The learning support administrator generated a list of students who fit the criteria as participants of the research: (a) traditional-aged 18 to 24 year olds, (b) successfully completed the developmental math sequence, and (c) successfully completed college algebra or elementary statistics. The potential participants were contacted by email and standard postal mail; they were
invited to a brief orientation of the study. They were asked to volunteer for the study and those who accepted were given a consent form. Nine volunteers were selected to be participants (Creswell, 2007), although the participants reserved the right to stop or cancel participation from the research at any time without consequences. A survey was given to all who volunteered for the study, and it was used to gather demographic information of each participant. This information was used to provide a detailed, personal description of each participant (Patton, 2002). A schedule of dates and times for interviews was arranged. Individual interviews were audio and video recorded, which made transcription easier and more accurate. The interviews were guided conversations or semi-structured questioning, although the interviewer had the fluidity of when to ask probing questions, when to explore a subject more in depth, or when to move on to the a new area of questioning (Patton, 2002). After each individual interview, the participant was asked if they would agree to meet in a focus group with other participants to answer similar questions. A focus group was scheduled and participants were chosen based on consent and availability. Focus groups ensure a stronger dialog occurred between participants. The idea is that participants may open up and be more expressive if there is a shared connection or conversation (Patton, 2002).

The data collected during interviews were coded for likenesses and variations. Careful analyzing and comparing of the data were completed to sift out the repetitive themes. In addition, field notes were documented to include observations, before and after interviews, environmental issues, interviewer thoughts, and other information.

Yin (2009) prescribed three principles of data collection: (a) utilize multiple sources of data, (b) establish a case study database, and (c) maintain a chain of evidence. Merriam (2009) and Yin (2009) stated that triangulation is the converging of multiple data sources; surveys,
interviews, focus groups, archival information, and field notes were the sources of data collected. Triangulation strengthened the credibility of the case study. A case study database contained the original or raw data obtained from the interviews, focus groups, field notes, archival documents, the audio and/or video tapes, and the researcher’s transcriptions of the interviews. A case study database significantly increased the reliability of the case study because no data was lost due to carelessness or bias; the case study report was written from the case study database (Yin, 2009). Maintaining a chain of evidence or data recreated the methodology for clear cross-referencing, documenting the time, data, and location of each interview, and preserving the facts that were gathered. Following these three principles provided reliability, validity, and trustworthiness to the case study.

**Research Questions**

How and why do students’ behavioral changes improve academic success in math courses and persistence at the community college level? The following research questions address the topic and drive the research:

**Research Question One:** How do community college students perceive their ability to perform successfully in college algebra or elementary statistics after completion of the developmental math sequence?

**Research Question Two:** How are community college students socially integrated on the community college campus?

**Research Question Three:** What are the academic support programs that community college students describe as contributors to academic success and persistence in college level math courses?
Setting

The setting for this research was a small, rural community college in Tennessee. The community college is located in a small town of about 17,000 people (U.S. Census, 2010). The community college has a main campus and two off-campus sites that serve the seven surrounding counties. The community college was established in 1969. It has 235 full-time faculty and staff members and 128 part-time faculty members. The community college’s 2013 fact sheet states the enrollment is 3,200 students (TCC (pseudonym), 2013). The rationale for selecting this site was due to access and location. A pseudonym was used instead of using the name of the institution to protect confidentiality.

The Tennessee Board of Regents (TBR) governs six state universities, 13 community colleges, and 27 technology centers serving over 200,000 students across the state of Tennessee. It is the governing body that strives to advance the education and skill levels of students in Tennessee through quality programs and services. The TBR establishes both standards for uniformity among the institutions and specific parameters to promote institutional flexibility and discretion (Tennessee Board of Regents, 2013).

For 2013-2014 academic school year, Tennessee Board of Regents designed TBRA-100 guidelines, new policy and guidelines for community colleges regarding developmental education programs (Tennessee Board of Regents, 2013). The new policy established a new name for Tennessee’s developmental education programs; they were called learning support programs. The purpose of the new guidelines was to “enhance students’ access to and success in higher education” (Tennessee Board of Regents, 2013). The new regulations specified ACT cut scores were lowered from 22 to 19 as the minimum score that places students in the developmental math sequence. Students scoring significantly lower than 19 were subject to
additional testing; however, students who scored below 12 were provided with strategies to address necessary learning supports to assist in their educational plan.

**Participants**

The method of obtaining participants was purposeful and convenience sampling. Purposeful sampling is a method of selecting participants who have experienced the phenomena that is the focus of the case study (Patton, 2002). A purposeful sample of community college students who have successfully completed the developmental math sequence ensured the desired participants. Convenience sampling provides data that is easily accessed and collected (Creswell, 2007). The following boundaries were set for the participants of this research: (a) traditional aged 18 to 24 year olds, (b) academic successful completion of the developmental math sequence, and (c) academic successful completion of college algebra or elementary statistics. Academically successful was defined as students earning a grade of a C or higher (Crynes, 2013; TCC (pseudonym), 2013; Greene, Marti, & McClenny, 2008; Hoyt, 1999; Reyes, 2010). The research targeted the academic success of students in college algebra or elementary statistics after completion of the developmental math sequence; therefore, the inclusion of students who earned a grade lower than a C could be deemed as unsuccessful and less likely to persist in their educational journey. The sample size was nine participants; this number gave sufficient opportunity to identify themes (Creswell, 2007). In qualitative case studies, the focus is on the in-depth, rich, descriptive narrative that is collected and not the number of participants (Yin, 2009). Pseudonyms were used for all participants and the institution. To help ensure the collection of accurate and insightful data, former students and graduates of the high school where I teach were not allowed to participate.
At the community college where the research was conducted, freshmen under 21 years old with scores on the ACT math portion of 21 or below were placed in a developmental math sequence (TCC (pseudonym), 2013). There are five developmental math levels of competencies available for students who are not ready for college level math courses. A student who is motivated and persistent may take all five developmental math levels in less than a semester.

The developmental math sequence is designed to improve basic math skills and prepare students for college level courses. There are 12 math courses that are understood to be college level courses; however, most students enroll in college algebra or elementary statistics. According to the community college’s course catalog, the college level math courses are Concepts of Modern Mathematics I & II; Finite Mathematics; College Trigonometry; Elementary Calculus; Calculus and Analytic Geometry I, II, & III; Linear Algebra; and Introduction to Differential Equations (TCC (pseudonym), 2013).

**Procedures**

Prior to requesting approval from Liberty University’s Institutional Review Board, I obtained written approval from the president of the community college where the research was conducted (Appendix C). The written approval letter from the president of the community college and the IRB application was submitted to Liberty University’s IRB. After IRB permission was granted (Appendix B), the learning support administrator at the community college where the research took place assisted in identifying students who qualified as potential participants. The learning support administrator generated a list of students that fit the criteria as participants of the research: (a) traditional aged 18 to 24 year olds, (b) successfully completed the developmental math sequence, and (c) academic successful completion of college algebra or elementary statistics. The potential participants were contacted by email and standard postal
mail. They were invited to a brief orientation of the research. The students were asked to volunteer for the study and sign the consent form. The first nine volunteers were selected to be participants; although the participants reserved the right to stop or cancel participation from the research at any time without consequences. A survey was given to all who volunteered for the study and was used to gather demographic information of each participant. This information was used to provide a detailed, personal description of each participant (Patton, 2002). As the primary researcher, I disclosed any bias and my role of the research. A schedule of dates and times for interviews was arranged. Participants were interviewed in a semi-formal, one-on-one manner using audio and video media for accurate transcribing purposes. The data collected were transcribed and analyzed. Coding was performed to identify quotes and phrases and to provide validation to data analysis (Creswell, 2007). After analyzing the data, re-coding was carried out to look for themes within the quotes, phrases, and words. Repetitive, significant statements were grouped into larger themes; then, meanings of the words were grouped into smaller themes. Re-reading, re-coding, and revising the data enabled the themes to emerge. The themes were coded based on the research questions but not limited to the research questions. Additional data or correction to the data may be needed for validation purposes. Confirmation of the collected data was accomplished by using member checks, and an electronic transcription of the interview was emailed to each of the participant. The participants replied giving their consent and approval of the interview transcription. Member checks are a method to ensure accurate meanings of the data by allowing the participants to read the narrative of their transcriptions and agree with the researcher’s translation (Stake, 1995). Additions or deletions of data were completed after member checks.
The Researcher's Role

As the primary researcher in this study, I disclosed any connection or biases related to the community college or the math curriculum at the community college where the research took place. Although, I am a graduate of the community college where the research was conducted, I do not have personal or professional connections to the community college. I was not related to or acquainted with any of the participants that could be viewed as having influence or authority over them.

I have been an educator in elementary, middle, or high schools for 20 years. Currently, I am a high school Algebra I teacher. The high school where I teach is a feeder school to the surrounding community colleges and four-year universities in Tennessee. However, it was not possible to have participants who were previous students of mine since my freshmen math teaching experience began two years ago.

In qualitative case study research, the researcher assumes the role of the human instrument (Lincoln & Guba, 1985). The task was to focus on the multi-layered human experience of achieving success and persistence in the math curriculum in the community college. As the primary researcher and investigator in this qualitative case study, I strived to provide my participants with an opportunity to voice their experience of academic math success (Yin, 2009).

As an educator in the public K-12 school system, I value education and encourage students to attend college. As a previous educator of students with special needs, I am empathetic to anyone who struggles with academics. As a mother of two college graduates, I want to empower other individuals, who have the desire to go to college, to reach for their academic goals, and obtain a degree.
Data Collection

In this research, data collection consisted of archival data, surveys, interviews, field notes, and a focus group. No data was collected until approval was obtained from Liberty University’s IRB, the president of the community college where the research was conducted, and the participants’ informed consents were given. The learning support administrator generated a list of students that fit the criteria as participants of the research: (a) traditional aged 18 to 24 year olds, (b) successfully completed developmental math, and (c) successfully completed college algebra or elementary statistics. Invitations to a meet and greet were sent to potential participants by email and standard postal mail. At the meet and greet gathering, the study was explained and students were asked to volunteer in the study. Students who volunteered for the study were asked to sign the consent form, and schedule an interview time (Appendix A). One-on-one interviews were audio and video recorded to ensure verbatim transcriptions. A focus group was utilized to achieve an atmosphere more conducive to conversation and used to gather data that may have been excluded during individual interviews (Patton, 2002). Follow up correspondences were needed to answer additional questions, provide clarity, and establish credibility to the participants’ narrative. Field notes were documented to include before and after interviews, environmental issues, interviewer thoughts, and other information. Lastly, participants were given a copy of the transcriptions of their interview and focus group comments, and were asked for feedback and validation of the transcription. Archival data was acquired and used as statistical background data. This data consisted of: (a) the percentage of students enrolled in the developmental math sequence, (b) retention rate, and (c) student enrollment in higher math courses. Students’ academic transcripts were self-reported. In this research, I used surveys, interviews, field notes, archival data, and a focus group. Multiple sources of data
collection triangulate the data and validate the transcriptions (Stake, 1995). Yin (2009) recommended six sources of data collection; “documents, archival records, interviews, direct observation, participant observation and physical artifacts” (p. 102). One source is not superior over the others; instead, they are complimentary of each other (Yin, 2009).

Survey

The survey (Table 1) was completed at the brief orientation meeting. The survey data was used to gather demographic information and this information was used to describe the participants in a rich, thick descriptive text (Patton, 2002).

Table 1

Survey Questions

________________________________________________________________________

Demographics- Please circle or fill in the blank

________________________________________________________________________

1. Gender:  male  female

2. Age:  18  19  20  21  22  23  24

3. Marital Status:  Single  Married  Divorced  Widowed

4. Ethnicity:  Caucasian  African American  Hispanic  Other

5. Do you have children?  Yes  or  No  If yes, how many ____ Ages ____ ____ ____

6. What educational year are you in now?

   Freshman  0 – 23 credits, Sophomore 24 – 59 credits, Sophomore + 60 credits

7. What is your academic major?

8. What is the math requirement for your specific major?
Interviews

Yin (2009) stated interviews are a crucial part of case studies. Semi-structured interviews were the format of the interview process. Participants were interviewed in one of the private study rooms at the community college’s Learning Resource Center. During each interview, audio and video recordings were completed to achieve verbatim transcriptions. My goal is to be an active listener. Rubin and Rubin (2005) emphasized qualitative interviewers are active and alert. The interview process is about gaining information regarding the topic; however more importantly, the interview is about gaining information regarding what the participant believes, feels, and understands about the topic (Rubin & Rubin, 2005).

The interview questions were designed to answer the research questions. The interview questions were peer-reviewed by three educators in the field of mathematics; they concluded that the interview questions should provide valuable data related to the research questions and the topic of the study. There was a pilot session with nonparticipants to assess if the researcher is asking appropriate questions and probing questions that prompt the interviewee to explicate in their answers (Stake, 1995). The pilot session revealed that the interview questions were appropriate and aligned to the topic of the study.

An interview guide (Table 2) was used to ensure that the same questions were asked of each participant; however, it did not confine the researcher from engaging in a conversation (Patton, 2002). The list of interview questions was divided into two sections. First, questions one and two were icebreaker questions that initiate conversation and build rapport. The icebreaker questions had the potential to provide in-depth knowledge into the participant’s experiences in math classes and in college life. Then, the icebreaker questions led to direct questions with an emphasis on the topics of academic success and persistence in college algebra.
or elementary statistics after completion of the developmental math sequence. My goal was to inquire about the participants’ viewpoints, feelings, and interests; as a result, I acquired rich, descriptive data.

Table 2

<table>
<thead>
<tr>
<th>Open-Ended Interview Questions</th>
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<tbody>
<tr>
<td>Ice breaker questions</td>
</tr>
<tr>
<td>1. Tell me how you felt when you registered at this community college. Prompting questions: Did you feel anxious? Did you feel excited? Did you feel worried?</td>
</tr>
<tr>
<td>2. Why did you choose this community college?</td>
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<tr>
<td>Success after developmental math (research driven questions)</td>
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<tr>
<td>3. Describe yourself when you were in middle school math class? High school Algebra? Or any math prior to college?</td>
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<tr>
<td>4. What types of support provided by the community college were available to you? Prompting questions: How did the community college help you to be successful?</td>
</tr>
<tr>
<td>5. How were you able to be academically successful in college algebra or elementary statistics? Prompting questions: What did you do to get good grades in math?</td>
</tr>
<tr>
<td>6. How did the relationships with faculty provide encouragement to be successful? How did others students provide encouragement to be successful? How did your family and/or friends provide encouragement to be successful?</td>
</tr>
<tr>
<td>7. Who or what provided motivation for you to stay in college? Prompting questions: Who or what kept you going?</td>
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</tbody>
</table>
8. Were you involved in sports, club affiliations, or religious organizations on the campus?

9. How are you different as a student now than when you first enrolled at this community college?

________________________________________________________________________

Focus Groups

A focus group was used to create an atmosphere more conducive to discussion. One focus group was utilized using three of the participants. During the focus group session, participants felt comfortable, relaxed, and communicated their experiences openly. Participants need not all agree, disagree, or problem-solve; it was a time to collect data in a social setting (Patton, 2002). In focus groups, a snowball effect can occur where the topic grows into larger discussions. Focus group questions (Table 3) one and two were ice breakers; questions three through nine addressed the research questions of the study. The focus group questions were similar to the interview questions with respect to the topic, ice breaker questions, and research driven questions; however, questions may become unstructured after the focus questions have been answered. I participated and acted as the rudder to keep the group on topic. All focus group members were encouraged to share their thoughts, experiences, and perceptions. Ground rules for the focus group were to respect each other’s views and their right to speak. Creswell (2007) stated the importance of each participant in the focus group is to have the opportunity to share his or her experience with respect to the topic.
Table 3

Focus Group Questions

Ice breaker question

1. State your name, the last math course completed and/or current math course enrolled, and academic major.

Success after developmental math (research driven questions)

2. Which academic support programs are you involved in at this community college?
   Prompts: Tutoring? Professor or peer-led study groups?

3. How are you socially involved at this community college? Club organizations? Political or religious organizations? Sports?

4. How would you describe yourself as a math student? How have you changed as a math student from the first time you enrolled until now?

5. Who or what pushes you toward completion of your educational program? Prompting:
   Parents, spouses, friends, children, inner self

Field Notes

Field notes (Appendix F) were recorded to document before and after interviews, facial expressions, body language, interviewer thoughts, dates, times, other expected and unexpected data. Patton (2002) stated that “Everything that goes on in or around the program is data” (p. 286). This type of data collecting allowed me to return to the data at a later time and recall specific surroundings and occurrences. Regarding field notes, Patton (2002) said, “Be descriptive, concrete, and detailed” (p. 303). Field notes allowed me to journal my perceptions,
ideas, insights as well as dates, places, and other circumstances. Field notes such as events leading up to the interviews, participants’ behaviors and body language, initial coding, reasons for follow up interviews, descriptive notes, and reflective notes were documented. Field notes were part of the case study database and ensured credibility.

Archival Data

Archival data was acquired from the community college and was used as statistical, background data. This data consisted of: (a) the percentage of students enrolling in the developmental math sequence, (b) retention rate, (c) student enrollment in college level math courses, and (d) degree completion rate. Students’ transcripts were not retrieved; students self-reported grades earned and coursework taken. The learning support administrator generated a list of students that fit the criteria as participants of the research: (a) traditional aged 18 to 24 year olds, (b) successfully completed developmental math, and (c) academic successful completion of college algebra or elementary statistics.

Data Analysis

The goal of data analysis is to analyze and synthesis the data collected (Merriam, 2009). As the primary researcher, I am the human instrument of the case study; therefore, my training, experiences, and ideas played a role in the collecting and analyzing of the data (Yin, 2009). Stake (1995) described analysis as “taking something apart” (p.71). I analyzed and synthesized the data collected to establish and convey meaning that was specific to the research questions, theoretical framework, and current literature.

Data analysis was accomplished by examining the surveys, one-on-one interviews, focus group sessions, archival documents, and field notes. These multiple data sources ensure triangulation, validation, and trustworthiness of the qualitative case study (Merriam 2009; Stake
1995; and Yin 2009). Data analysis began with the first piece of data collected and continued throughout the data collection process (Merriam, 2009; Stake, 1995). Merriam (2009) stated that researchers should not wait until all of the data is collected to begin with analysis since the opportunity to gather more reliable data could be lost. Stake (1995) suggested that data analysis begins with a “first impression” (p.71).

Direct interpretation, categorical aggregation, and pattern matching of the surveys, individual and focus group interviews, and field notes added depth and richness to the research (Stake, 1995; Yin, 2009). All data collected was analyzed separately, then, collectively. Specifically, each participant’s interview was dissected separately; then, categorical aggregation of the participants’ interviews was examined for common themes, reoccurring words or phrases, and how they related to each other, the research questions, theoretical framework, and current literature (Stake, 1995). Therefore, individual and focus group interviews were analyzed by establishing patterns from the data collected. This type of analyzing and synthesizing of data strengthened my findings of the case study.

During the data analysis, I used detailed descriptions of the participants’ conversations, body language, and the documentation in the field notes. Detailed descriptions assisted in establishing associations between the participants’ responses, body language, and the researcher’s focus of inquiry. The focus of inquiry was to explore how and why students’ behavioral changes improve academic success and persistence in their college algebra or elementary statistics after completion of the developmental math sequence.

Words, phrases, themes and patterns were categorized and compiled into a clear, useful, and living document. The process of coding “disaggregates the data, breaks them down into manageable segments, and identifies or names those segments” (Schwandt, 2007, p. 32). In data
analysis, the use of coding means to highlight words or phrases, develop rich, descriptive texts, and give validation to the case study (Creswell, 2007). I used a highlighting tool, word wall (Appendix H), and ATLAS.ti, a computerized data coding program, to code the data.

Transcribing the interviews provided an opportunity to be immersed in the data collected. While transcribing, I used the Microsoft Word highlight tool to begin highlighting the data and identifying reoccurring words or phrases. This type of analyzing of the data encouraged “pattern matching” to occur; patterns that correspond or overlap provides “internal validity” (Yin, 2009, p. 136). Re-reading, re-coding, and re-checking the data was crucial to the emergence of themes. Themes emerge after careful, repetitive listening to the interviews and reading the transcriptions, field notes, and archival documents (Stake, 1995). I began the coding process by constructing a word wall (Appendix H) to display the highlighted data. On the word wall, similarities and differences of the categories were divided and sectioned. Repetitive, significant words or phrases were grouped into larger categories or themes; in addition, constant comparison throughout the different data sources was achieved and led to specific, streamlined themes. The word wall is similar to Stake’s (1995) “correspondence tables” that identify the patterns of significant data (p.78). In addition, ATLAS.ti, a computerized data coding program, was used to assist in the coding process. This data coding program retrieved codes that co-occur across all or specific data collections.

**Trustworthiness**

Re-reading, revising, re-labeling themes, the use of participants’ voices and perspectives, and member checks secured trustworthiness. The use of participants’ specific word choices and phrases allows for rich, descriptive language. Member checks provided validity and clarity of
the participants’ transcriptions. Member checks were accomplished by allowing the participants to read and agree with the accuracy of the interview transcription.

Yin (2009) prescribed three principles of data collection that provide reliability, credibility, and trustworthiness to the qualitative case study. In the case study, the three principles of data collection were to utilize multiple sources of data, establish a case study database, and maintain a chain of evidence. Surveys, interviews, focus groups, field notes, and archival documents were sources of data. The case study database contained the original or raw data obtained from the interviews, focus groups, archival data, the audio and/or video tapes, and the researcher’s transcription from the interview. A case study database significantly increased the reliability of the case study by organizing the data (Yin, 1999). Maintaining a chain of evidence recreated the methodology for clear cross-referencing, document the time, data, and place of an interview, and preserve the data that was gathered.

**Ethical Considerations**

During and after this research, specific ethical considerations were in place. The participants and community college involved in the study were assigned pseudonyms. All data collected was kept in a locked storage container and password protected computer. All data collected will be kept for three years after research is concluded; at that time, proper disposal of all data will be handled appropriately.

An explanation of the purpose in the research, how it was used, and how the participants had the final say in their transcriptions were provided. Patton (2002) suggested the purpose statement be brief, direct, and easily comprehensible. Before the interview, participants were given a copy of the interview questions guide. Participants performed member checks by reading and agreeing with the transcriptions of their interviews; participants validated the
“accurate reflection of what they said” (Creswell, 2007, p. 45). The participants were informed that they can stop or cancel participation from the research at any time without consequences.
CHAPTER FOUR: FINDINGS

Overview

The purpose of this research was to explore how and why community college students were academically successful in college algebra or elementary statistics after completion of the developmental math sequence. The research study suggested that future students, parents and educators may become aware of behaviors and supports that will improve students’ academic achievement and persistence in math. The theoretical contribution of the current qualitative study showed how students who were academically involved, established faculty relationships, and perceived themselves as in control of their successes improved their academic performance (Deil-Amen, 2011; Dweck, 1996; Rattan, Good, & Dweck, 2011; Tinto, 1997; 1998). A purposeful sample of community college students who have successfully completed the developmental math sequence and college algebra or statistics ensured the desired participants.

In this chapter the data collection and analysis procedures, the participant’s background information, the participants’ responses to the research questions, and the findings of this study are presented.

Data Collection

A case study was suitable for gaining insight and understanding how and why some college students were successful in college level math courses after completing the developmental math sequence (Stake, 1995). A qualitative case study allows researchers to capture the holistic and significant descriptions of real-life events (Yin, 2009). Data was collected through interviews, field notes, and a focus group session to explore how and why students’ behavioral changes improve academic success in college level math courses and persistence at the community college level. Patton (2002) stated, “Raw field notes and verbatim
transcripts constitute the undigested complexity of reality. Simplifying and making sense out of that complexity constitutes the challenge of content analysis” (p. 463).

**Data Analysis**

Data analysis consisted of four phases. The initial phase began with transcribing the interviews and the focus group session. The second phase utilized the highlight tool in Microsoft Word to highlight reoccurring words and phrases. The third phase was the construction of a word wall (Appendix H) to display word or phrase commonalities. The final phase was the use of ATLAS.ti, a computerized data coding program used to code qualitative research studies.

During the first phase, I listened to each interview in its entirety. Then I transcribed verbatim the participants’ interviews and the focus group session. I included the participants’ facial expressions and body language, my perceptions and thoughts, and my field note remarks. This phase was valuable in capturing the rich, descriptive narrative of each participant’s interview and the focus group session.

In the second phase, I used the Microsoft Word highlight tool to begin highlighting the data and identifying reoccurring words or phrases within each interview as I read and re-read the transcriptions. Then, examining all of the interview transcriptions combined provided a cross-case analysis. This type of analyzing of the data encouraged *pattern matching* to occur; patterns that correspond or overlap provide *internal validity* (Yin, 2009, p. 136). The participants shared similar aspects of their successful math experiences and this established patterns to emerge from the interviews and the focus group session.

During the third phase, I constructed a word wall (Appendix H) to create sections of similarities and differences of the categories. Repetitive, significant words or phrases were grouped into larger categories or themes; in addition, constant comparisons throughout the
different data sources were achieved and led to specific, streamlined themes. Organizing the data into significant themes were reflective of the three research questions.

In the last phase, ATLAS.ti, a computerized data coding program, was used to assist in the coding process. This data coding program retrieved codes that co-occur across all and specific data collections (Appendix I). The use of the ATLAS.ti software program was beneficial in providing a platform to code the data using direct interpretation and categorical aggregation. It tallied the number of similar responses that the participants gave during the interviews and focus group session.

**Participants**

Participants were obtained through purposeful. Purposeful sampling is a method of selecting participants who have experienced the phenomena that is the focus of the case study (Patton, 2002). A purposeful sample of community college students who have successfully completed the developmental math sequence ensured the desired participants. The following boundaries were set for the participants of this research: (a) traditional aged 18 to 24 year olds, (b) completion of the developmental math sequence, and (c) completion of college algebra or elementary statistics. Table 4 depicts the demographic information of each participant; pseudonyms were used.
Table 4

*Demographics of Participants*

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Marital</th>
<th>Ethnicity</th>
<th>Grade</th>
<th>Credit</th>
<th>Academic Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dana</td>
<td>21</td>
<td>Married</td>
<td>African American</td>
<td>Sophomore</td>
<td>60+</td>
<td>Psychology</td>
</tr>
<tr>
<td>Jonathan</td>
<td>19</td>
<td>Single</td>
<td>African American</td>
<td>Sophomore</td>
<td>24-59</td>
<td>Pre-occupational Therapy</td>
</tr>
<tr>
<td>Blaine</td>
<td>21</td>
<td>Single</td>
<td>Caucasian</td>
<td>Sophomore</td>
<td>24-59</td>
<td>Business Management</td>
</tr>
<tr>
<td>Amy</td>
<td>19</td>
<td>Single</td>
<td>Caucasian</td>
<td>Freshman</td>
<td>0-23</td>
<td>Criminal Justice</td>
</tr>
<tr>
<td>Cheryl</td>
<td>23</td>
<td>Single</td>
<td>Caucasian</td>
<td>Sophomore</td>
<td>24-59</td>
<td>Nursing</td>
</tr>
<tr>
<td>Wayne</td>
<td>23</td>
<td>Married</td>
<td>Caucasian</td>
<td>Sophomore</td>
<td>60+</td>
<td>Education</td>
</tr>
<tr>
<td>Emma</td>
<td>18</td>
<td>Single</td>
<td>Hispanic</td>
<td>Freshman</td>
<td>0-23</td>
<td>Biology</td>
</tr>
<tr>
<td>Peyton</td>
<td>18</td>
<td>Single</td>
<td>Caucasian</td>
<td>Freshman</td>
<td>0-23</td>
<td>General Studies</td>
</tr>
<tr>
<td>Aaron</td>
<td>20</td>
<td>Single</td>
<td>Caucasian</td>
<td>Sophomore</td>
<td>60+</td>
<td>English</td>
</tr>
</tbody>
</table>

Each participant’s background information is presented along with how they described their concerns regarding enrollment at the community college. The names are listed in the order of the schedule of interviews. As noted previously, all names that follow are pseudonyms.

**Dana**

Dana is a young woman with determination to be successful and graduate with an associate’s degree within the next year. She described herself as a good student who worked
hard at earning a grade above a C. She was not afraid to ask for help from instructors and peer tutors. She expressed concerns when she entered the community college. “I was terrified because it was waking up on my own and I was scared of not knowing my professors and the other students. You know it was the fear of the unknown.” Dana has plans to join the navy after earning her degree.

**Jonathan**

Jonathan is a quiet, focused young man who wants to become an occupational therapist and help others gain independence and mobility. He stated, “I was nervous and excited about starting college ‘cause I knew it would be different from high school.” He had to work at math skills in order to be successful. He spent many hours studying and working in the math lab. “I worked problems over and over ‘til I felt comfortable with it.” After two more semesters, Jonathan plans to transfer to a four-year college and earn a degree in occupational therapy.

**Blaine**

Blaine is an out-going young man who aspires to own his own business after obtaining a degree in business. He explained his concerns with enrolling into a community college; “I was worried because I didn’t do good [sic] in high school. I mean I goofed off in high school. When I first started I struggled when I came here. I had a rough time getting through the basics.” Blaine plans to transfer to a four-year university or begin a managerial apprenticeship program in a local grocery store.

**Amy**

Amy is a career-oriented young woman who wants to become a policewoman with the local police department. I asked her about how she felt when she enrolled at the community college, “I was actually pretty excited. At first, I had pretty easy classes. Second semester I got a
little worried.” She stated that while she liked math she had to study more and ask questions to be successful in her math classes. “Um, it was actually one of my better subjects. I love math. It’s awesome. I don’t know why I like math. I always made B’s and C’s in math.” Amy said that she had difficulties being successful on tests. “I got a 17 on the ACT test. I’m not a good test taker.” Amy plans to earn an associate’s degree in criminal justice.

Cheryl

Cheryl is a 23 year old woman who wants to become a pediatric nurse. I asked her how she felt when she first enrolled at the community college, and she said:

Well, the first thought that was going through my head was, um, well I wasn’t really that excited because I never thought I’d graduate. First thing nobody in my family they never graduated from high school. My mom and dad only have a 10th grade education. And everybody else they didn’t except my grandma but she passed away and my cousin graduated that’s the only two people and I was the third person to graduate. And I was scared to go to college I didn’t think I was smart enough. I really didn’t think I would graduate high school because everybody else didn’t.

Cheryl is trying to get into the nursing program at the community college; however, she feels that she will need to transfer to a four-year college in order to earn certification as a pediatric nurse. She explained, “They [hospitals] want their nurses to have a bachelor’s degree and not a [sic] associate’s degree.”

Wayne

Wayne is a 23 year old married male with two young children. He hopes to teach history at the local high school. Immediately after high school, Wayne went to work at a local factory. After two years, he was laid off and made the decision to go to college. When asked how he felt
upon enrolling at the community college he said, “I didn’t know what to expect. I was excited, apprehensive, uh, I mean I didn’t know what to expect from my professors.” He stated that he was the first to go to college in his immediate family. “To me and my family, it’s a big deal for me to be successful and earn my degree.” Wayne will transfer to a four-year university next semester to complete his history and secondary education degree.

Emma

Emma is an 18 year old female student who wants to work as a veterinarian technician. She explains, “I love animals! I’m probably better with animals than I am with people.” I asked her how she felt when she enrolled at the community college and she stated:

I was pretty excited but then I was disappointed too because I wanted to go to a bigger college but we didn’t have the money to go there so I ended up going here. Actually it is a really nice place and I do enjoy coming here ‘cause you get to meet a lot of people.

Emma went on to say that she felt it was best to attend a community college because it is a small campus and she has established close friendships with a few other students.

Peyton

Peyton is an 18 year old female who has not decided on a major or career at this time; however, she stated, “I want to be successful at whatever I decide to do.” I asked her how she felt upon enrolling at the community college. She said, “Uh, I was excited but I was scared at first because I was like coming out of high school and I was like wow I’m really in college this came fast.” Peyton describes herself as a serious student who sets her own academic goals. I asked her if she targets a specific grade in her math classes. She stated, “Well everyone wants an A. But I won’t accept anything lower than a B. I like having A’s and B’s.”
Aaron

Aaron is a 20 year old male who wants to teach English at the local high school or community college level. I asked him how he felt when he enrolled at the community college, he said:

I was worried and excited. I was worried that I wouldn’t be able to do the work and make good grades. I just got by in high school but I wanted college to be different. I wanted to be successful.

Aaron earned a scholarship to play baseball at the community college and is interested in coaching baseball in the future.

Results

A thorough analysis of the interview transcriptions, focus group transcription and field notes resulted in four themes and six subthemes. This section is organized thematically; then, it will finish by answering the research questions.

Themes

Emergent themes came from the data collected after listening, transcribing, and reading the participants’ answers to interview and focus group questions. Patton (2002) stated, “Findings emerge out of data, through the analyst’s interactions with the data” (p. 453). The themes emerged from word repetition, significant words or phrases, and the participants’ similar features of successful math experiences. Four strong themes that emerged from the data

- ability to succeed,
- academic support,
- involvement and behavior changes, and
- connectedness to faculty members.
During the interviews, I noticed that all of the participants were goal oriented and focused on their educational success. As I transcribed and read the participants’ dialog, the following sub-themes began to emerge: (a) self-motivation, (b) ownership of their education, (c) family support, (d) social integration, (e) extra-curricular activities, and (f) the use of the math lab.

Table 5

Number of Participants’ Responses Connected to Themes

<table>
<thead>
<tr>
<th>Coding</th>
<th>Ability to Succeed</th>
<th>Academic Support</th>
<th>Involvement and Behavior Changes</th>
<th>Connectedness to Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner drive</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraged</td>
<td>7</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Focused</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determined</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studious</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal oriented</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familial support</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty relationships</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Sought help</td>
<td></td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Self-disciplined</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One on one instruction</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Motivated</td>
<td>7</td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Get ahead in life</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good grades</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning strategies</td>
<td></td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Repetitive practice</td>
<td></td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Desire to succeed in life</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helpful professors</td>
<td>9</td>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>
Table 5 (cont.)

Number of Participants’ Responses Connected to Themes

<table>
<thead>
<tr>
<th>Coding</th>
<th>Ability to Succeed</th>
<th>Academic Support</th>
<th>Involvement and Behavior Changes</th>
<th>Connectedness to Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedicated</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supportive</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours spent math lab</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Learned how to study</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer tutoring</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Teachers helped a lot</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study groups</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caring faculty</td>
<td>9</td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Math lab well-staffed</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Faculty approachable</td>
<td></td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Attended Christian luncheon</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Play baseball</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Interested in extra-curricular activities</td>
<td>9</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Responsible student</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time management</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

**Ability to succeed.** Dweck (1996) stated that when students take ownership of their education and believe that with time and effort they can improve their academic success; in addition, they perceive themselves as having the ability to be successful. In the nine interview transcriptions, there were 77 words or phrases that were connected to the ability to succeed
theme. Self-motivation, ownership of their education, and family support were sub-themes that emerged from the main theme. The participants provided rich texts in the description of their ability to be successful.

**Self-motivation.** The participants described their academic success as self-motivation and a personal drive. All of the participants stated that they possessed an inner drive to be successful in all of their courses and earn a degree. Dana added, “You would just have to have a lot of motivation to push yourself and encourage yourself every day. It has to be something inner or it’s not going to work.” Aaron stated, “I know what I have to do to be successful and I’m ready to get it done.” Amy remarked, “I want to succeed in life so I can get what I need and everything.” When asked about what motivates her, Amy added, “Um, it’s inner. It really is for me.” Wayne agreed, “And a lot of it [motivation to succeed] was internal.” When asked about what motivates her, Cheryl said, “It was more from me. I wanted something better for myself.”

The findings revealed that the participants’ motivation to succeed with the short term goals were due to their vision and desire for the long term goals they have planned for their future.

**Ownership of education.** The participants displayed ownership of their learning and education. They described themselves as academically successful students and talked about how they achieved the academic success. Dana expressed that attending college was different than high school; parents are not watching to ensure that you do the work and make the grade. Dana noted, “You have to motivate yourself for one thing and you have to self-discipline because you can do the math on your own schedule.” Wayne said, “I was driven. I wanted to be successful.” He added that he feels an urgency to finish his degree because his wife is working and supporting the family while he attends college. Peyton stated that she placed an emphasis on focusing on her academics instead of relationships and having a social life. Three of the
participants suggested that success in college equates success in their career choices. Aaron had this to say about what motivates him, “I want to make them [mom and dad] proud of me. Well, they are proud of me they tell me that all the time.”

**Family support.** All of the participants mentioned their families and how they contributed to their desire to be successful. I asked Peyton about her family and the support that they provided for her, she noted, “They are very supporting. I still live at home with my family so they are very supportive.” Wayne explained that his wife is supportive and his children are understanding when he has to study. Amy and Cheryl stated how their mothers are a source of motivation to complete a college degree. In addition, when Cheryl graduates, she will be the first to graduate from college in her family. She mentioned this several times during the interview. Aaron shared that his source of motivation was family support: “I’ve watched them [mom and dad] work hard to provide me with things clothes and baseball equipment and lessons.” Emma stated that her grandmother is influential as an education support person. Blaine noted, “My mother pretty much provided me with motivation to stay in college and myself. I knew I needed to stay in college ‘cause the job market out there is where you absolutely have to have a college education.” Dana indicated that her mom and grandmother are supportive and urged her to do well and complete her education. Dana revealed that her mom is enrolled in the same community college at this time. Jonathan stated, “I’m doing it [earn a degree] for myself but I’m doing it for my brother and mother too.” Jonathan added that his brother was an inspiration to him because his brother has physical and cognitive disabilities due to an accident. The participants stated that they were self-motivated; however, all of the participants indicated that having familial support was an important part of their educational success.
Academic involvement and behavior changes. The participants discussed how their behavior changes led to academic involvement which resulted in academic success. The combination of academic involvement and social integration reinforced the students’ commitment to their educational goals. Social integration was defined as the interactions between faculty and students in addition to the relationships among students (Sidelinger, Bolen, McMullen, & Nyeste, 2014; Tinto 2006). The academic involvement encompassed the subthemes: social integration and extra-curricular activities.

Social integration. The participants’ descriptions of social integration were connected to the faculty interactions, peer study groups, or time spent in the math lab. The participants’ social integration was academic in setting but social in nature. The participants described their interactions with the faculty and staff in the classroom and the math lab as being caring, encouraging, and helpful. Students developed relationships with other students by studying and learning together. Jonathan described how students would email each other and share their work on specific math problems. Amy stated how she worked with students who were on her math level. Wayne remarked, “There were about six students that got together at least once a week and talked about the work that we were doing in class or any problems that we were having.” Two of the participants enjoyed the Christian fellowship with the weekly luncheons. Aaron said, “On Wednesdays, they [BCM] have a lunch and fellowship which is pretty nice. Some of us [baseball players] go to that.” Dana stated, “We [students] were always ready for Wednesday to come around, you know, food, talk and then go back to class. The fun stuff like games and BCM was encouraging for me.” Emma explained, “I’m not a big social person.” Emma added that she does not feel comfortable in social settings; however, she and her sister, who is an online college student, study together at home. The social time that students spent with other students was
limited; however, the time was meaningful to their academic involvement. Social integration and academic involvement were intertwined which made it difficult to view the borders between them.

**Extra-curricular activities.** Eight of the nine participants stated that they wanted to be involved in sports, club affiliations, or religious organizations, but did not want to take away from their study time. Each made a conscious decision to focus on academics. All nine of the participants planned to become involved in an extra-curricular activity after their first year; however, only one participant engaged in a sport and he and another participant attended the weekly BCM luncheons. Five of the other seven participants stated their interest in specific clubs or organizations. Dana wanted to be a cheerleader. Wayne expressed an interest in participating in the intramural sports on campus. Amy’s interest in police work triggered her interest in joining the criminal justice association. Peyton was in band during high school; therefore, she expressed an interest in the music club. Cheryl was in the psychology club briefly until her job prevented her from attending the meetings. I felt the subtheme of extra-curricular activities must be included due to the references that the participants made regarding the desire to become involved in the clubs, sports, and organizations.

**Connectedness to faculty members.** This theme was mentioned in 34 responses from the participants’ interviews. The participants explained how relationships with the faculty helped them to achieve academic success. Blaine said, “What set me up to be successful in college algebra is really the support of the professor.” Wayne stated, “In college the instructors were very patient. I felt that I could get him and her involved in my studies whenever I needed them. I felt fortunate to be where I was in college algebra.” Jonathan described his interactions with the faculty as “teacher student relationships” that were supportive and available. Emma
described the faculty as approachable and interested in their students’ success. Dana explained that when she went to the math lab she would request a specific teacher to work with her because she felt more comfortable working with her. She said, “They make it to where whoever you are more comfortable with, they get used to who you ask for if you need help ‘cause you’re more comfortable talking to that person.” The findings revealed that the connectedness with faculty members and staff directly influenced the math success of the participants.

**Academic support.** While coding the interviews and focus group session, I had difficulty differentiating the participants’ responses regarding academic support and their relationships with faculty members.

**Faculty relationships.** The academic support and relationships with the faculty were intertwined due to the faculty’s involvement with their students. Participants mentioned the math lab as their academic support; however, they could not mention the math lab without stating that the math lab teachers were instrumental in their success. The participants’ responses regarding connectedness to faculty members are documented in the above section.

**Math lab.** At the community college where the research took place, a math lab was mandatory for all students enrolled in the developmental math sequence, college algebra, and statistics. Eight out of nine participants spoke of the math lab favorably and attributed academic success to their time spent in the math lab. One participant had completed the developmental math and college algebra before the math lab was a requirement to pass these courses; therefore she did not have positive or negative remarks to make regarding the math lab. The participants who engaged in the math lab indicated that they spent more than the required time in the math lab. The participants revealed that the environment of the math lab was conducive to learning in addition to being a relaxed, comfortable atmosphere. Dana added that students would use the
math lab as a place to set up study groups, “We [students] would all go to lab at the same time and help each other if we knew another person wasn’t understanding it but the math lab was like a study session for some students.” Jonathan enjoyed the online math videos which allowed him to watch them as often as he needed. Amy indicated that the level of expertise of the faculty and staff was wonderful and the math lab was well staffed.

**Research Questions**

The participants’ answers to the interview questions provided data to answer research question one of how they viewed themselves as successful math students, research question two regarded the behavior changes they initiated to become successful in math, and research question three discerned the academic supports that the participants found to be beneficial to their success in college level math courses are presented. The following research questions addressed the topic and directed the research:

**Research Question One:** How do community college students perceive their ability to perform successfully in college algebra or elementary statistics after completion of the developmental math sequence? The importance of this question is to hear the voices of the participants describe their perception and description of achieving academic success. In addition, the participants reflected on their successful journey through the developmental course and the success they have experienced in college algebra or elementary statistics. These students perceived themselves as successful math students. Interview questions (Appendix D) three and nine and focus group questions (Appendix E) four and five addressed how the participants perceived their ability to be academically successful and persistent. Interview question one prepared the participants to describe experiences, feelings, and thoughts as math students.
The participants in the focus group described themselves as math students and how they changed as a math student from the time they enrolled until the present. Dana stated, “I’m a better math student now but I’m a better student all together. I have learned so much about myself and the way I learn than when I was a freshman.” Cheryl said, “Better. I am better than when I first started college or when I was in high school.” Jonathan stated, “I was a weak student when I was a freshman but now I feel like a good student and I make decent grades.”

Participants were asked to describe how they perceived themselves as successful in the college level math course. All nine of the participants showed ownership of their education as they described how they were in control of their education. Wayne said, “I felt fortunate to be where I was in college algebra. I felt that there was a lot of help around me. I was doing better in math than any other time in my life.” Jonathan explained how he felt in control of his learning, “I wasn’t good in math in high school but I feel like I know how to do the math in college now. It was hard but I got it now.” Blaine explained how he felt in control of his education by attending the math lab regularly and asking for help from the professors.

In addition to describing their perceptions of achieving math success, the participants discussed their future plans. All of the participants suggested that the success in developmental math and the college level math course encouraged their plans for the future. When I asked Cheryl about her future goals, she said, “I’ll probably go to Baptist [School of Nursing] ‘cause I’m going for my nursing and they are requiring more bachelor’s than associates. I knew I needed the math to prepare me to be a nurse you know the math that nurses’ use every day.” Wayne stated, “I feel confident that I will be successful when I transfer to UT [University of Tennessee]. And I know I will be an awesome history teacher.” Jonathan expressed his interest in occupational therapy, “I know that the math classes were just classes that I needed to get to
where I really want to be. I want to work with people and help them live out on their own.” I asked Blaine about his graduation plans and he said, “Yes, I will finish with a [sic] associate’s degree in business. I plan on being a store manager somewhere. I should graduate next fall.” Dana explained, “I plan on going into the military. After I serve a certain amount of years then I plan to go back to school and get my bachelor’s degree in psychology.” Amy said, “When I turn 21, I’m going to try and get a job on the police force here. I want to eventually be a detective.” Aaron said, “I am focused on finishing here and transferring to UT. I know what I have to do to be successful and I’m ready to get it done.” When asked about her future plans, Emma said, “I want a great job working with animals. I’ve always wanted to get a degree in biology. So I always knew I wanted to go to college.” One participant was undecided about her future goals. Peyton stated, “I don’t know what I want to be when I grow up, but I know that I want to be successful and that’s why I self-drive myself.” The findings indicated that all of the participants possessed an inner drive to be successful in their education.

**Research Question Two:** How are community college students socially integrated on the community college campus? Tinto (1997) stated students who persist through post-secondary education develop academic involvement and social integration. Tinto (2006) redefined social integration as a sense of being an engaged individual on the community college. Students who felt connected to the institution and their learning were socially integrated. In addition, Tinto (2006) emphasized that social integration included interaction with faculty and staff in a formal (classroom) and an informal (math lab) system. Therefore, the involvement and integration of these participants occurred in an informal academic setting. Research question two addressed three components: (a) the behavior changes the students made to ensure academic success, (b)
the social integration with faculty, staff and peers, and (c) the extra-curricular activities that were available.

The participants were prompted to examine behavior changes and decisions that connected them to their coursework and the community college. Participants identified changes in their behavior that enabled them to be academically successful in the developmental math sequence and college algebra or elementary statistics. Students who are socially connected to other students and faculty at the community college are more likely to remain enrolled and achieve academic success (Barnett, 2011; Deil-Amen, 2011; Tinto, 2006). Interview questions (Appendix D) six, seven, and eight addressed this research question by inquiring who or what provided strength to be academically successful and persistent. This research question was concentrated in the focus group question (Appendix E) three; discussion was directed toward social events, groups, and/or settings at the community college.

All nine of the participants voiced behavior changes that led to their success in the developmental math and college level math courses. Develop time management skills, study more, use different learning strategies, and be more responsible were the behavior changes that the participants identified. The behavior changes were unique to each participant. Two participants explained how they made decisions to be responsible students. Dana stated, “I have gotten my priorities together.” Cheryl stated, “I’m a determined student. I learned that if you want to do something with your life you have to stay in school and study hard.” Four participants changed the approach they used to study and learn. Wayne explained, “I had to learn how to be a student and focus on my studies and homework. Now it is second nature to focus and learn and get my work completed.” Aaron noted, “I stayed up on all of my assignments. Don’t get behind because it’s hard to catch back up.” Emma said, “I make sure I
study for all the quizzes and tests.” Blaine said, “I went to the math lab every single day and worked. I was in the math lab more than anybody else. The more and more you practice and learn the more successful you will become.” Two participants established study groups with their peers to ensure they were successful in the math courses. Peyton stated, “I have a friend that I go to the math lab every Friday and we just we’re like basically on the same pace with our work. I’ll ask her or she’ll ask me if we need help or have questions.” Wayne said, “There were about six students that got together at least once a week and talked about the work that we were doing in class or any problems that we were having.” Three participants discussed how they managed time to study and complete assignments. Emma said, “I make sure I get all of my work turned in on time.” Jonathan remarked, “They [professors] required us to spend two hours a week in the math lab. But I still worked I say about three or four hours more in there [math lab] to get a good feel of it [math problems].” Amy explained, “I’m better at time management and because in high school everything was given to you and like do this and this and this. But in college it’s different.” The focus group participants described the changes in behavior that fostered their math success. Dana explained, “I know that I have to set aside time for my work and to study for tests.” Jonathan added, “Yeah. I know how to study now. Going to the math lab and watching videos helped me know how to study for my math tests.” Cheryl said, “I take a lot of notes. I write everything down all of the math problems then I go back and look over them when I’m working on homework or studying for a test.”

Eight out of nine of the participants wanted to be active on campus but for different reasons they decided not to participate in extra-curricular activities. I asked the participants about their involvement with extra-curricular activities such as sports, religious organizations and club affiliations. Six out of nine participants stated that they were not involved in extra-
curricular activities for concern the activities would take away from their studies and hinder earning an acceptable grade. Peyton stated, “I planned to get involved in something but I wanted to see how my first year goes.” Wayne explained, “I was aware that sports and religious organizations were available but I didn’t want to give up my study time and home life time to attend those functions.” I asked Emma about her interests in engaging in extra-curricular activities and she stated, “No, I’m not. I’m not a big social person so I don’t go to things like that; plus, I just want to focus on my classes and grades.” One participant, Aaron, plays baseball for the community college and he attends the luncheons at the BMC. Another participant did not attend extra-curricular activities on campus, but he volunteers some of his time to community agencies. Jonathan said, “No, not on campus but I volunteer at the animal shelter and the Red Cross.” I asked the focus group participants about their involvement with extra-curricular activities. All three of the participants restated that initially they wanted to be active in something on campus; however, they were more concerned about academics and earning a passing grade in their courses. Jonathan said, “I am not involved in any sports or clubs at this time. I wanted to be in something but I thought I needed to focus on my studies so I just never did.” Dana stated that she wanted to be a cheerleader during her freshman year; however, now she feels that extra-curricular activities would not fit into her busy schedule with a job and a husband. Jonathan added, “Yeah that’s me now. I just want to get done.” Cheryl agreed, “Now I’m not interested in joining [a club]. I just want to graduate.” Three participants were working while attending college and indicated that they had little time for extra-curricular activities. Blaine stated, “I’m not involved in any sports…I do not attend any club or religious events on campus. I work at Kroger and when I’m not working I’m studying.” Dana stated, “I didn’t feel like I had enough time to include the sports and activities like when I was at high school ‘cause I
didn’t have a job then.” All of the participants expressed a desire to be actively involved on the college campus; however, emphasized their focus was on academic success.

The participants were encouraged to discuss their relationships with faculty members. All of the participants specifically named professors or staff that contributed to their math success. Aaron stated:

Well, Mr. Bobby [college algebra teacher] helped me tremendously. When he explained it [math] to me, it made sense. He’s a great teacher and he cares about his students and their success. Really, all of the instructors that I’ve met or had in class were helpful.”

Wayne said, “They [professors] were very open to me knocking on their office door and asking can you help me. They were always receptive to my needs. They never asked me to come back later.” Peyton said this about her college algebra professor, “Yes, he is great. He makes his office hours available and the times that he’s in the math lab.” She added this regarding the same professor: “I knew him before he was my math teacher. I’ve known him ever since I was a kid.” She went on to say this about other professors: “The faculty members are helpful and here for the students.” Amy stated, “Oh yeah, I don’t know how many times I would stop my teacher in the hallway and ask a statistics question. She was very helpful.” When I asked Cheryl to describe the math teachers that she had in class, she said, “Awesome.” Dana stated:

There was a couple of them [professors] that I worked with and got used to me coming in there and if I had free time in between classes, I was in there a lot until I got out of college algebra.

The participants indicated that the faculty and staff wanted to get to know them and took an interest in them as math students and individuals. Blaine stated, “Well I had good relationships with the teachers. They got to know me really well. We talked about math and fun things.”
Emma said, “They are really helpful and even if you’re just sitting there quietly doing your work they will come over and ask if you need help with any of your work. I think they are really interested in the students here.” During the focus group session, the participants added that the faculty and staff were available and patient with them in solving math problems. Cheryl said, “I worried the fire out of my instructors going by their offices especially Ms. Williams. She helped me a lot.” Dana said, “Yeah, I forgot about her but she was good to help me too.” Jonathan stated, “Mr. Solomon helped me he would explain things over and over and that’s the way I get things.” The participants’ remarks and descriptions of the faculty revealed that the relationships with the faculty and staff provided encouragement to be successful and persist in their education at the community college.

**Research Question Three:** What are the academic support programs that community college students describe as contributors to academic success and persistence in college level math courses? The emphasis on this question is to establish the support programs that influenced academic success and persistence in math. The participants indicated that the math lab was the primary source of academic support. In addition, the faculty and staff provided mentoring during the time the students were in the math lab. The participants stated that they formed study groups that served as an academic support. This research question was addressed in interview questions (Appendix D) four and five and the focus group question (Appendix E) two addressed what academic supports were available to the math students.

At the community college where the research was conducted, all students enrolled in a developmental math or any college level math course since 2012 were required to attend the math lab for two hours a week. Any time over the mandatory two hours spent in the math lab was student-initiated. The participants utilized the math lab in different ways. Blaine said, “The
math lab it’s just a very helpful environment once you walk in there you will get any type of support you need.” When asked about peer study groups Blaine said, “…when there were kids in the math lab we would help each other when doing our homework.” Emma said, “There’s plenty of chances for tutoring ‘cause they have a lab where you get tutoring any time of day. The math lab is where you do your homework and you can get help.” I asked Jonathan to describe the math lab, and he said, “There’s two to four teachers in there and some students in there to help.” The math lab provided students with the academic support they needed to complete assignments, take quizzes, and tests. Jonathan added that the online videos were helpful in refreshing his memory and brushing up on skills before tests. Wayne said, “I knew I needed more practice on my math. I contacted my teachers and they were more than happy to help me.” In addition, the math lab provided a location for students to meet and study together. Wayne added, “There were about six students that got together at least once a week and talked about the work that we were doing in class or any problems that we were having.” I asked Dana if she ever participated in a study group and she said, “We would all [students in her college algebra class] go to lab at the same time and help each other if we knew another person wasn’t understanding it but the math lab was like a study session for some students.” I asked the focus group participants about academic supports that were available to them. Dana stated, “The math lab helped me. It made me accountable for my assignments and getting my work completed.” Jonathan said, “I liked the math lab. There was always plenty teachers in there. They helped a lot.” Cheryl explained that the math lab was not available during her developmental math class and college algebra course. She said, “I was here before the math lab. Teachers do come in there and help you but it’s different not having a book.”
Since the math lab was mandatory, the data collected did not conclude that it was a strong academic support for math students. The participants answered the questions regarding the math lab; however, they did not continue to refer back to it as a main support to their math success. The participants indicated that the interaction with faculty members provided support and influenced their achievement in the math courses. The findings suggested formal and informal interactions with faculty members in the math lab.

**Field Note Findings**

Before and during each interview, all of the participants demonstrated attentiveness to the interview questions. Two of the participants were apprehensive before the interview began for fear that I would ask them to solve a math problem. As soon as I presented them with a copy of the interview questions, they calmed down. All participants seemed interested in contributing to the research and answering the interview questions. The participants’ behaviors and studious actions reinforced research question one. Upon arriving at the college’s Learning Resource Center (LRC) where the interviews took place, I noted that seven of the nine participants were studying while waiting for me to arrive. All seven stated that they come to the LRC almost daily so it was a normal routine for them to come and study. The students perceived themselves as successful math students. As for the two participants who were not waiting and studying, I had to wait for their arrival. After the interviews, six of the participants stayed at the LRC to use the computers or study at one of the tables. One participant had to leave to go to work while the other two left because they rode with another individual. The participants’ expressions and choice of words supported research question two by stating the level of involvement they have with their education.
Archival Data Findings

The archival data included the previous two years of statistics from the community college. It was retrieved by the learning support coordinator and from the Tennessee Higher Education Fact Book 2012-2013 and 2013-2014. The success rate of students who enrolled and completed the developmental course sequence referred to the number of full-time and part-time students who were enrolled in any developmental course who then successfully completed college-level courses in a subsequent semester within three years of their initial enrollment. In the fall of 2012, there were 1694 total enrollment of first time full time students and 1420 enrolled in the developmental math sequence courses which represented 83.8% of the incoming first time full time students. In the fall of 2013, there were 1039 total enrollment of first time full time students and 793 enrolled in the developmental math sequence courses, which represented 76% of the incoming first time full time students. For the 2012-2013 school year, the success rate of developmental math sequence course completion was 67%. The percentage of students completing developmental math and enrolling in a college level math course in 2013-2014 is 10%. This archival data is representative of the current literature data. Sixty-seven percent of all community college freshmen are placed in a developmental math sequence (Bailey, Jeong, & Cho, 2010). In addition, seventy-five percent of the community college students who are enrolled in a developmental math sequence do not earn a passing grade and finish the course (Bahr, 2012a; Bailey, 2009; & Fain, 2012).

Summary

In this chapter, the findings of the research were discussed. Triangulation among the different types of data collected from each of the participants provided validation and supported the themes. The four themes that emerged from the data collection, analyzing, and coding were
ability to succeed, academic support, involvement and behavior changes, and faculty relationships. Research questions one, two, and three were reintroduced and answered using the participants’ rich texts collected from the interviews and the focus group session. The purpose of this research was to explore how and why community college students were academically successful in college algebra or elementary statistics after completion of the developmental math sequence. The theoretical framework was grounded in two theories: Dweck’s (1996; 2006) incremental theory of intelligence and Tinto’s (1997) theory of persistence. The constructs of these theories include ownership of one’s education, self-motivation, and academic support. The research found that students’ perception of their ability to succeed, self-motivation, family support, faculty relationships, and academic support were all contributing factors of students’ achieving academic success.
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Overview

The purpose of this qualitative case study was to explore how and why students’ changes in behavior influenced academic success and persistence in their math courses at the community college level. For the purpose of this study, the students’ changes in behavior that influenced academic success and persistence in their math courses were generally defined as involvement in academic support programs, integration into social groups, and the perception of their ability to perform in the college level math curriculum. Throughout this study, the intent was to explore the participants’ historical and social perspective through their descriptions and perceptions from developmental math through college algebra or elementary statistics. Chapter five consists of the summary of the findings, discussion of the findings, implications of literature and theoretical frameworks, limitations, future recommendations, and the conclusion.

Summary of the Findings

Community college students who were successful in the developmental math sequence and college level math perceived themselves as successful math students. They believed that with self-motivation, hard work, effort, and connectedness with faculty members academic success would be achieved (Dweck, 1996; Roberts & Styron, 2010). The purpose of the current research was to explore how and why students’ changes in behavior influenced academic success and persistence in their math courses at the community college level. The changes in behavior that improved academic success and persistence in their math courses were categorized as involvement in academic support programs, social integration, and a positive perception of their ability to succeed in the community college’s math curriculum. The current research study addressed a gap in the literature: few qualitative research studies have addressed the how and
why some students are academically successful in college algebra or elementary statistics after completing the developmental math sequence (Bachman, 2013; Koch et al., 2012). Furthermore, there has been qualitative research that studied the students while enrolled in developmental math (Ashby et al., 2011; Bahr, 2012a, 2012b; Bailey et al., 2010; Crynes, 2013; Fike & Fike, 2012). The current qualitative case study focused on community college students after successful completion of the developmental math sequence and a college level math course.

In the current study, interviews were conducted with nine community college students who fit the criteria of the research: (a) traditional aged 18 to 24 year olds, (b) successful completion of the developmental math sequence, and (c) successful completion of college algebra or elementary statistics. Successful completion in the developmental math and college level math courses was characterized by earning a grade of a C or higher (Crynes, 2013).

An analysis of the participants’ perceptions and descriptions supported the findings connecting the interview and focus group questions to the research questions. Emerging themes were derived from the coding and re-coding of the individual participant’s quotes, words, and phrases; then, coding and re-coding all of the participants’ dialogues collectively. This allowed significant, repetitive, and similar dialogues to transpire. The emerging themes were (a) the ability to succeed, (b) academic support, (c) involvement and behavior changes, and (d) connectedness to faculty members.

The current research was significant in revealing how and why students’ changes in their behavior influenced academic success and persistence in their math courses at the community college level. There was significance in using the constructs of Dweck’s (1996) incremental theory in order to identify the malleable and controllable traits that the participants used to describe themselves as successful math students. The participants described how they perceived
themselves as successful math students, accepted ownership of their learning and education, and interacted with faculty members to build relationships. There were three research questions that addressed the topic and directed the study.

How do community college students perceive their ability to perform successfully in college algebra or elementary statistics after completion of the developmental math sequence? The importance of question one was to hear the voices of the participants describe their perceptions and descriptions of achieving math success. The participants reflected on their successful journeys through the developmental math sequence and the success they have experienced in college algebra or elementary statistics. In addition, these students perceived themselves as capable, productive college students. Dweck (1996) stated that when students take ownership of their education and learning, they believe that with time, effort, and performance they can improve their academic achievement. The participants showed ownership and pursuit of their educational program. The participants described themselves as successful math students who were focused, determined, and self-motivated. The participants shared how they achieved math success through hard work, effort, and persistence. In addition, they attributed their success to familial support, caring teachers, and an inner drive.

How are community college students socially integrated on the community college campus? Question two prompted the participants to examine behavior changes and decisions that connected them to their coursework and the community college. Tinto (1998) stated in order for students to persist in their post-secondary education goals they must be academically involved and socially integrated in the community college. Participants identified changes in their behavior that enabled them to be academically involved in the developmental math
sequence and college algebra or elementary statistics. The students explained that they had to initiate study groups, use learning strategies, and become responsible students.

Students who are socially connected to peers and faculty members at the community college are more likely to remain enrolled and achieve academic success (Barnett, 2011; Deil-Amen, 2011; Tinto, 1997). The participants’ social integration was concentrated to the math lab where there were more opportunities to socially interact with peers and faculty. The participants were asked to explain their social integration with faculty and peers at the community college. All of the participants described the math lab as a social experience as well as a learning environment. While in the math lab, these students expressed that the faculty and staff assisted with math problems and in addition got to know them better through casual conversation. These conversations between faculty and students initiated a connectedness that the students perceived as advantageous and necessary to their math success.

The participants were socially connected through their academics instead of the more familiar social aspects such as sports, clubs, and organizations. There was a strong connection to the faculty members who tutored, mentored, or taught them. Participants expressed that their success was due to the faculty members being approachable and receptive to their academic needs. The social interactions that the participants described between faculty members and other students were primarily accomplished in the math lab. Students who were socially connected to their peers and faculty members were likely to succeed and persist in their educational program (Tinto, 1997; 1998).

Findings indicated the students’ changes in their behavior that helped to achieve math success included: (a) utilizing time management, (b) studying, (c) being responsible, and (d) using learning strategies. The participants revealed that they had to learn strategies that enabled
them to become better students and increased their math performance. Some of the strategies included rote memory, mnemonic devices, and repetitive practice.

What are the academic support programs that community college students described as contributors to academic success and persistence in college level math courses? The emphasis on question three was to establish the support programs that influenced academic success and persistence. Mentoring, learning community programs, tutoring services, and the use of the math lab provide community college students with the support they need to stay enrolled and achieve academic success (Crisp, 2010; Engstrom & Tinto, 2008; Halcrow & Iiams, 2011; & LaManque, 2009). The students acknowledged that the math lab, their peers, and the faculty members were the academic supports at the community college.

The math lab was instrumental in the students’ math success. It was in the math lab where the social integration with the faculty and peers occurred most often. The participants spent the required time in the math lab plus additional time to ensure mastery and success. The participants expressed that the faculty got to know them well during the time spent in the math lab. Tinto (1998) stated that community college students’ academic involvement and social integration may only be experienced in the classroom. Karp et al. (2008) affirmed that academic involvement and social integration are determinants to persistence of community college students. These researchers found that academic involvement and social integration are not separate; “the two forms of integration are developed simultaneously, through the same activities” (p. 18). They added that classrooms designed to be student centered are more conducive to promote social integration and academic involvement. The participants indicated that the math lab was student centered and the interaction with the faculty and peers in the math lab influenced their math success.
Discussion

The themes and subthemes of the current study support these theories and current literature. There were four themes:

- ability to succeed,
- academic support,
- involvement and changes in behavior, and
- connectedness to faculty.

The sub-themes were commonalities that were intertwined throughout the four themes and the theoretical framework. The subthemes included: (a) self-motivation, (b) ownership of their education, (c) family support, (d) social integration, (e) extra-curricular activities, and (f) use of the math lab.

For the current research, the theoretical framework was based on the theory of persistence (Tinto, 1997, 1998) and the incremental theory of intelligence (Dweck, 1996, 2006). The theory of persistence states that students who are academically involved and socially integrated on the college campus are academically successful and persistent with their degree or certification (Tinto, 1997, 1998). The incremental theory of intelligence suggests that students see themselves as in control of their successes and believe that through hard work and effort their academic performance will be improved (Dweck, 1996; Rattan, Good, & Dweck, 2011).

Findings supported the constructs of Tinto’s (1997, 1998) theory of persistence. Socio-academic integrative situations reinforced Tinto’s theory of persistence and were voiced by the participants. These situations included: (a) student centered classrooms, (b) student led study groups, (c) positive faculty interactions, and (d) peer interactions with others with similar
academic needs (Deil-Amen, 2011). The participants described how these events assisted in their success and to remain enrolled at the community college.

The current study’s findings confirmed another construct of Tinto’s theory of persistence which was academic involvement improves academic achievement. The participants were academically involved in their educational program, even though two participants had to enroll in the developmental math sequence twice before they experienced math success. All of the students stressed the importance to be prepared and attend class, complete assignments on time, ask for assistance when needed, and plan and study for quizzes and tests. They established timelines to complete courses and set goals to earn the grade they wanted in the courses. The participants were focused on their math success and were persistent at the community college.

In the current study, findings indicated that the participants possessed traits of the incremental theory of intelligence (Dweck, 1996). The participants believed that through hard work, effort, and determination they would be academically successful; all nine of the participants were successful math students. They transitioned from being unsuccessful math students to successful math students by using learning strategies and studying techniques to become a skilled math student. The students’ perceptions of themselves as successful math students increased as they earned higher grades, experienced confidence with math skills, and progressed through the developmental math sequence and a college level math course. They acknowledged their family, peers, and the faculty as necessary supports that encouraged their success; however, primarily their success was attributed to their own behaviors and motivation. The participants described their internal influences as being focused, having determination, and staying motivated while external influences were family support, study groups, and the math lab sessions. The traits of individuals who possess the incremental theory were reflective in the
sample of participants who volunteered for this study. The current study’s findings were positive in nature and reinforced previous literature (Rattan et al., 2011; Shively & Ryan, 2013).

The current study’s findings indicated that the participants possessed the abilities to be academically successful in college level math. The participants understood their area of weakness and considered it to be a challenge to increase their skill level and become a better math student. The participants articulated how they were able to be successful; they stated that they were self-motivated, self-disciplined, and encouraged by their families. The participants believed in their ability to be successful in math and, ultimately, were successful in the developmental math and college level math courses. The words and phrases used by the participants to describe their self-motivation were “I’m focused, I pushed myself, it’s something inner, I worked hard, and I stayed motivated.” All of the nine participants were attentive to their educational programs and conscientious about the grades earned in all of their courses. All of the participants possessed an inner drive that pushed them to succeed in the math courses. Two other qualities the participants possessed were an increased level of confidence and a positive attitude.

The participants were in control of and owned their learning and education. Students who take an active role in their education and assume ownership of their education are more likely to be successful and remain enrolled in college (Rodgers et al., 2012). The participants described themselves as “determined, focused, driven, serious, and proud.” They talked about establishing priorities, setting goals, and following through with them. The participants communicated their future goals and career plans; eight out of the nine participants had decided on a major and knew the requirements needed to earn their degree. The participants expressed why they mapped out their future career goals and worked toward completion of those goals.
The reasons that the participants stated were to make a living, help others, secure their future financially, or pursue a dream.

Findings indicated that all of the participants had some type of family support, which included parents, grandparents, siblings, and spouses. Familial support is an external influence and one that supplies a strong influence to succeed. The participants acknowledged that their families provided support, encouragement, and inspiration to enroll and stay in college. Dana, one of the participants, was attending college with her mother and they were in college algebra together. Jonathan has two sisters who were attending the community college at the same time and he explained that they formed study groups at home. Peyton stated that both of her parents have college degrees and they are insistent that she stay in college and earn a degree. She said, “They were always asking about where I wanted to go to college, not if I wanted to go so I just always knew that I would go.” Six out of the nine participants stated that they were the first person to attend college in their family and will be the first to complete a college degree or certificate. For this reason, their families were especially proud of them.

Students were academically involved in their learning and educational program. According to Tinto (1996, 2006), students must be proactive and make changes in their behavior that will initiate involvement on the community college campus. The participants expressed a variety of changes in their behavior that influenced their academic success. All of participants stated that completing assignments on time was an important component to their math success. Two of the students noted they learned time management; this was key to completing assignments and setting aside time to study. Two other participants stated that attending the math lab daily improved their understanding of the math skills. Learning how to study, focus, and complete assignments were mentioned by all of the participants. The focus group
participants remarked that taking good notes, watching math videos in the math lab, and asking for help were behaviors that guided their math success. The students realized that they had to make changes in their behavior and be involved in their learning to achieve the math success that they desired.

The current study’s findings disclosed that social integration occurred in an academic setting. The participants indicated that social integration occurred with faculty and peers in the math lab regularly. The participants explained that peer study groups would meet in the math lab. Students would go to the math lab with a friend and study together. One participant stated that the students in college algebra shared their email addresses and would use that method to ask for help or set up a study group at the learning resource center. The students benefitted from the social integration with other students who shared common goals; the math lab provided an environment where the students could work together to achieve those common goals. Social integration provided students with comradery, reliability and consistency that were key influences to student persistence and academic success as has been reported by other researchers (Tinto, 2006; Kelly et al., 2012).

The current study’s findings revealed that two of the nine participants were involved in extra-curricular activities. Interestingly, the other seven participants expressed that they wanted to be involved in sports, clubs, or organizations during their first year at the community college; however, they were concerned that their grades would suffer and they would not be as successful. One participant was involved in baseball and he stated that his involvement was due to a love for the game and to prepare him to coach in the future. He and another participant were involved in attending the weekly BCM luncheon. Dana, one of the participants, said the luncheon was a great way to socialize and take a break from class. Although the other seven
participants stated that their focus was on coursework and completion of their degree or certification, all seven admitted that they wanted to be actively involved in extra-curricular activities at the beginning of their freshman year. The participants’ narratives indicated that they were remorseful regarding not participating in extra-curricular activities. Five of the seven participants named cheerleading, the music club, the psychology club, the criminal justice association, and the intramural sports club as the organizations or clubs that interested them.

The success of the math lab and how it encouraged social and academic integration were included in the study’s findings. The academic supports that enabled the students’ success were their relationships with faculty members and the use of the math lab. The participants could not discuss the math lab without the constant references to the faculty and staff that assisted them in the math lab. Students who were enrolled in the developmental math sequence and college algebra course were required to spend two hours a week in the math lab. All of the participants noted that they spent the required time, plus additional time, in the math lab. Students explained that they met peers in the math lab to study and help each other. The students explained how watching the math videos in the lab were beneficial to their understanding of concepts and skills. There were three to five teachers and a student worker in the math lab most of the time. The participants felt comfortable with asking for help from the teachers in the math lab; however, the participants stated that the teachers readily approached them and inquired if they could offer assistance. Another advantage of the math lab was that students worked at their own pace and this encouraged students to own their own education.

The participants attributed their success to the relationships they experienced with faculty members. Faculty members proved to be a valuable resource for the students and their math accomplishments. The participants described their connectedness to faculty members as being
“professional, positive, caring, and consistent.” The actions of the teacher, particularly in the classroom, are instrumental to increasing students’ persistence (Tinto, 2006). The participants named specific teachers who were influential in their math success. All of the participants expressed that the math teachers had nurturing, caring, and approachable qualities. The participants indicated that the teachers respected, recognized, and valued them as students and individuals. Barnett (2011) stated the importance of teacher validation of their students to encourage persistence and academic success. In this study, the findings confirmed that the relationships between faculty and students possessed a greater influence to the students’ success than the relationships between students. Furthermore, positive relationships with professors and positive experiences in required courses were influences that encourage students to persist (Kelly et al., 2012). The participants felt in control of their successes and the support of their professors added to their sense of control.

**Implications**

The current study has theoretical, practical, and methodological implications for incoming college freshmen, parents, and educators of students who struggle in mathematics. The current research presented a platform for successful math students to voice their experiences of success in the developmental math sequence and a college level math.

The current study has theoretical implications connected to Tinto’s (1998) theory of persistence and Dweck’s (2006) incremental theory. Tinto’s (1998) theory of persistence states that students who view their academic involvement as productive and feel integrated into the community college experience are likely to persist. The successful math students felt connected to the faculty and involved in their learning and education. They indicated that faculty support and their desire for an education were key factors to their persistence and achieving math
success. This study allowed educational institutions and faculty members to realize how the connectedness between student and faculty was crucial to ensuring students’ success and persistence in the community college. Community colleges could create opportunities such as luncheons or other social gatherings for faculty and students to interact outside of the instructional classroom.

Dweck’s (2006) incremental theory suggests that students who accept ownership their education and believe that with effort, hard work, and time can achieve academic success. The successful math students stated that their success came from within; self-motivation, focus, and personal drive were key. This research provides students, parents, and teachers with insight of the how students with a positive perception of their ability enables them to be academically successful. This research implies that students with self-motivation and an inner drive to succeed are more likely to be successful math students. Furthermore, students who have internal and external influences are more likely to be successful math students.

The current study has practical implications for college students who are enrolled in the developmental math sequences, parents of these students, and educators who teach students who will be placed in the developmental math courses. In the current case study, the students were motivated and determined in the success and persistence of math skills; parents of struggling math students should encourage their children to engage in self-motivation techniques and self-confidence strategies so that they could be more likely to succeed and persist in the developmental math sequence and a college level math course. Educators of struggling math students could create activities and assignments that would prearrange students’ incremental success in their math skills. Educators may need to set students up to be successful in their math curriculum. Additionally, the use of progressive grading could provide educators with a tool to
help students increase their math grade. With progressive grading, higher grades are achieved as the students gain more skills. In the case study, the participants attributed their best advice concerning math success to incoming freshmen who are placed in the developmental math sequence. Dana described herself as self-motivated and this quality provided her with the strength to continue and succeed. All of the participants recommended to incoming freshmen to be aware of completing and turning work in on time, attending class, and ask for help when needed. Incoming freshmen students could benefit from the community college establishing a peer mentoring program which would allow students who had successfully completed the developmental math sequence to mentor incoming freshmen and model the behavior that encouraged their success. Another practical implication is the significance of the math lab at the community college where the research was conducted. Teachers who tutor and mentor students in the math lab establish relationships between themselves and their students. This research confirmed that the math lab and the faculty who worked in it were influential in students’ math success and persistence. Therefore, it would be beneficial for community colleges to implement the math lab as a reinforcement to the instructional classroom.

The methodological implication included the ease of duplicating this study at other community college campuses in the United States. Expanding the study of successful math students to other areas of the country would be beneficial to students who are struggling in mathematics yet need the success in college level math. Sharing how students can become successful in developmental math and college level math can inspire other students.

Limitations

Delimitations are the boundaries set for this case study. They include the selection of the participants’ math courses, participants’ ages, location, and the decision to establish the grade of
a C or higher as academic success. The participants for this study were those who are currently enrolled at a community college, have successfully completed the developmental math sequence and college algebra or elementary statistics, and are between the traditional college ages of 18 to 24. The use of traditional aged students narrowed the case study by using a more defined group of participants (Bean & Metzer, 1985). Academic success in the developmental and college level math courses was limited to a grade of a C or higher (Crynes, 2013; Hoyt, 1999; & Reyes, 2010) since students who have received a grade lower than a C were at a much higher risk of failing the course and dropping out of college (Crynes, 2013; Greene et al., 2008; Hoyt, 1999; & Reyes, 2010).

Limitations are the weaknesses of the study. There were two limitations within the sampling parameters. The use of only traditional aged students 18 to 24 years old instead of nontraditional aged students was an area of limitation. Geographical location due to the site being a small, rural community college in Tennessee was another limitation to the current case study. There were no parameters set for gender, ethnicity, or marital status which may be considered as limitations of the study.

The math lab at the community college may have been a limitation since it was a requirement for the students to attend. The participants indicated that the math lab was where they felt the most connected to the faculty and received one-on-one instruction. Results may have been different if there were no math lab which brought the students and faculty together.

**Recommendations for Future Research**

It has been found that students who do not complete the developmental math sequence are more likely to drop out of college or choose a vocational certification that does not require math competency (Bahr, 2012a; Crynes, 2013; Engstrom & Tinto, 2008; Fike & Fike, 2012;
Melguizo, Bos, & Prather, 2011). However, previous research was lacking in regard to students’ specific behaviors and behavior changes that improved success and persistence in developmental math and college level math courses.

The current research explored how and why students who began in developmental math achieved academic success in a college level math course. The study was conducted by using surveys, interviews, a focus group, field notes, and archival documents. Recommendations for future research include a qualitative study using participants who have graduated after beginning their college experience in the developmental math sequence. Another recommendation is to explore other community colleges that do not utilize a math lab to accompany the math instruction and skills. Additional recommendations include using a phenomenological approach and incorporating the use of observations as well as interviews.

Summary

The current research provided insight and greater understanding in how and why students can achieve academic success in college level math after completing the developmental math sequence. The data were collected from the interviews and a focus group using the participants’ voice, dialog, and words to provide a rich, descriptive text of their own personal experience. Field notes, demographic surveys, and archival data were documented. The themes and subthemes developed from the participants’ answers to the interview questions. The participants shared how their ability to succeed, academic support, involvement and behavior changes, and connectedness to faculty members encouraged their math success. Participants stated that self-motivation, owning their education, and family support helped their ability to succeed. Social integration and extra-curricular activities were key factors in their behavior changes and choices.
The community college’s implementation of a math lab provided the academic support and encouraged student and faculty relationships.

The theories of Tinto (1998) and Dweck (2006) provided the theoretical framework of the research. The participants illustrated academic and social involvement, persistence, and a belief in themselves as successful math students. The students were focused on academic involvement to ensure math success at the community college. The social involvement was isolated to faculty to peer and peer to peer interactions. The students’ persistence in developmental math and college level math was achieved. The students believed in themselves and described their math journey as successful.

The participants’ descriptions of their math success presented one of pride, accomplishment, and determination. Their struggles, setbacks, and hard work were noted; however, their efforts, performances, and achievements were empowering to them as students and young adults.
REFERENCES


doi:10.2190/CS.12.1.c


doi: 10.1002/cc.352


doi: 10.3102/0034654310370163


Li, K., Zelenka, R., Buonaguidi, L., Beckman, R., Casillas, A., Crouse, J., Allen, J., Hanson, M.


Appendix A: Consent Form

Community College Students’ Success and Persistence in Math Courses after Developmental Math: A Case Study

Robin N. Bontrager
Liberty University
School of Education

You are invited to be in a research study of how and why students’ behavioral changes improve academic success and persistence in college algebra or elementary statistics after completion of the developmental math sequence. You match the criteria to be a participant in this study. I ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Robin Bontrager, a doctoral student at Liberty University in the School of Education.

Background Information:

The purpose of this study was to explore how and why students’ behavioral changes improve academic success and persistence in their math courses at the community college level.

Procedures:

First, a list will be generated by the learning support administrator of potential participants who fit the criteria of the study. Then, the potential participants will be invited to a meet and greet orientation session. I will review the contents of this Consent Form including the purpose of the study, procedures, risks and benefits, compensation, confidentiality, and the voluntary nature of the study. Volunteers will complete a survey. The survey will gather demographic information. Students’ transcripts will be self-reported. Completing the survey does not obligate you to participate in the study nor does it guarantee you will participate in the study.

Archival data will be acquired and used as background statistical data such data will consist of the percentage of students enrolling in developmental math course, retention rate, enrollment in higher math courses, and degree completion rate. Then, the interview process and data collection will begin.

If you agree to be in this study, I would ask you to do the following things:

1. Participate in a 60-75 minute interview and follow up. One-on-one interviews will be audio and video taped to ensure verbatim transcriptions. Follow up interviews will be needed to answer additional questions, provide clarity, and establish credibility to the participants’ narrative. Field notes will be documented to include pre and post interviews, environmental issues, interviewer thoughts, and other information. Each participant will be allowed to read their interview responses, focus group, and field notes in narrative form.
2. Participate in a 45-60 minute focus group comprised of three or four participants. Focus groups will be utilized to achieve an atmosphere more conducive to conversation.

Overall, the time commitment involved in this research study will be 115-135 minutes spanning a three week period.

**Risks and Benefits of being in the Study:**

No study is without risks; however, this study presents minimal risks no more than the participant would encounter in everyday life. Participants will be asked to discuss past failures which could cause some discomfort. In addition, participants will review the successes in their math classes which could provide a sense of accomplishment and pride. Participants will provide insight and understanding into how and why community college students are successful in math courses after being placed in a developmental math course. This could be beneficial to future students, parents, educators, and/or administrators.

Liberty University will not provide medical treatment or financial compensation if you are injured or become ill as a result of participating in this research project. This does not waive any of your legal rights nor release any claim you might have based on negligence.

**Compensation:**

Refreshments will be served at the meet and greet orientation and the focus group session. Participants will receive a $20.00 gas card from a local gas station or a $20.00 gift card from a local restaurant or coffee shop.

**Confidentiality:**

The data collected in this study will be kept in a locked storage cabinet and a password protected computer at the researcher’s home. Research procedures are designed to protect the confidentiality and privacy of the participant. The online or paper survey form does not record your name. Participants’ demographics are recorded as data information. Data will be stored for the amount of time necessary to complete, confirm, and publish the research report. The data will be stored for three years after which the data will be destroyed in an appropriate manner to maintain privacy and confidentiality.

**Voluntary Nature of the Study:**

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University, Dyersburg State Community College, and any math courses. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

**Contacts and Questions:**

The researcher conducting this study is Robin Bontrager. You may ask any questions you have now. If you have questions later, you are encouraged to contact me at (731) 334-2214 or rbontrager@liberty.edu. You may contact my dissertation chair Dr. Nathan Putney at nputney@liberty.edu.
If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), you are encouraged to contact the Institutional Review Board, 1971 University Blvd, Suite 1837, Lynchburg, VA 24502 or email at irb@liberty.edu. (Please do not remove the IRB contact information from your consent document.)

You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

I consent to participate in individual interviews. □ Yes □ No

I consent to participate in a focus group interview. □ Yes □ No

I consent to audio recording. □ Yes □ No

I consent to video recording. □ Yes □ No

Signature: ________________________________ Date: ________________

Signature of Investigator: ______________________________ Date: ________________

IRB Code Numbers: (After a study is approved, the IRB code number pertaining to the study should be added here.)

IRB Expiration Date: (After a study is approved, the expiration date (one year from date of approval) assigned to a study at initial or continuing review should be added. Periodic checks on the current status of consent forms may occur as part of continuing review mandates from the federal regulators.)
Appendix B: IRB Approval Letter

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

July 23, 2014

Robin N. Bontrager
IRB Approval 1914.072314: Community College Students’ Success and Persistence in Math Courses after Developmental Math: A Case Study

Dear Robin,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Please retain this letter for your records. Also, if you are conducting research as part of the requirements for a master’s thesis or doctoral dissertation, this approval letter should be included as an appendix to your completed thesis or dissertation.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

Fernando Garzon, Psy.D.
Professor, IRB Chair
Counseling

(434) 592-4054

LIBERTY UNIVERSITY

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Appendix C: Community College Permission Letter

July 18, 2014

Institutional Review Board of Liberty University

To Whom It May Concern:

I am writing to give my permission to Robin Bontrager to utilize the staff, to recruit students, and to conduct the study on the campus as required for her Doctorate Degree.

If you need additional information or have any questions, please don’t hesitate to contact me.

Sincerely,

President
Appendix D: Interview Questions

Ice breaker questions

1. Tell me how you felt when you registered at this community college. Prompting questions: Did you feel anxious? Did you feel excited? Did you feel worried?

2. Why did you choose this community college?

Success after developmental math (research driven questions)

3. Describe yourself when you were in middle school math class? High school Algebra? Or any math prior to college?

4. What types of support provided by the community college were available to you? Prompting questions: How did the community college help you to be successful?

5. How were you able to be academically successful in college algebra or elementary statistics? Prompting questions: What did you do to get good grades in math?

6. How did the relationships with faculty provide encouragement to be successful? How did others students provide encouragement to be successful? How did your family and/or friends provide encouragement to be successful?

7. Who or what provided motivation for you to stay in college? Prompting questions: Who or what kept you going?

8. Were you involved in sports, club affiliations, or religious organizations on the campus?

9. How are you different as a student now than when you first enrolled at this community college?
Appendix E: Focus Group Questions

Ice breaker question

1. **State your name, the last math course completed and/or current math course enrolled, and academic major.**

Success after developmental math (research driven questions)

2. **Which academic support programs are you involved in at this community college?**
   
   *Prompts: Tutoring? Professor or peer-led study groups?*

3. **How are you socially involved at this community college? Club organizations? Political or religious organizations? Sports?**

4. **How would you describe yourself as a math student? How have you changed as a math student from the first time you enrolled until now?**

5. **Who or what pushes you toward completion of your educational program? Prompting: Parents, spouses, friends, children, inner self?**
Appendix F: Field Notes Template

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Who was there?</th>
<th>What happened?</th>
<th>Researcher’s reflections</th>
</tr>
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### Appendix F: Field Notes Template

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Who was there?</th>
<th>What happened?</th>
<th>Researcher’s reflections</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/5/14</td>
<td>Dana</td>
<td>Intro. Explained study, signed consent</td>
<td>P. dressed professionally, happy, analytic, excited about learning</td>
</tr>
<tr>
<td>9-8-14</td>
<td>Jonathan</td>
<td>P. Studying in LLC, intro. Explained study, signed consent</td>
<td>P. soft-spoken, shy, determined to complete college</td>
</tr>
<tr>
<td>9-15-14</td>
<td>Blaine</td>
<td>P. Studying in LLC, intro. Explained study, signed consent</td>
<td>P. very open, introverted, strengths in math, school wants to be successful</td>
</tr>
<tr>
<td>9-18-14</td>
<td>Amy</td>
<td>P. Studying outside the LLC, intro. Explained study, signed consent</td>
<td>P. easy to talk with, very social, wants to be a police officer, interesting</td>
</tr>
<tr>
<td>9-18-14</td>
<td>Cheryl</td>
<td>P. on computer in the LLC, intro. Explained study, signed consent</td>
<td>P. seemed nervous at first, asked if she would have any math to do, very sweet and caring, wants to be a nurse</td>
</tr>
</tbody>
</table>
Appendix F: Field Notes Template

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Who was there?</th>
<th>What happened?</th>
<th>Researcher's reflections</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-2-14</td>
<td>Wayne</td>
<td>P. studying in lab, introduction explained study</td>
<td>P. very mature, well spoken, appreciative of college experience, very driven</td>
</tr>
<tr>
<td>10-30-14</td>
<td>Peyton</td>
<td>P. introduced study, signed consent</td>
<td>P. friendly, talkative</td>
</tr>
<tr>
<td>10-30-14</td>
<td>Emma</td>
<td>P. studying in lab, introduced study, signed consent</td>
<td>P. seemed rushed, but answered questions stated she was in a hurry</td>
</tr>
<tr>
<td>11-4-14</td>
<td>Aaron</td>
<td>P. introduced study, signed consent</td>
<td>P. energetic, talkative, confident, very proud of his achievements</td>
</tr>
</tbody>
</table>
Appendix H: Word Wall Sample
Appendix I – Sample of ATLAS.ti Coding Report

Report: 77 quotation(s) for Ability to Succeed (This is a sample of the coding report)

HU: Research Coding Interviews
File: [C:\Users\Robin\Desktop\Research Coding Interviews.hpr7]
Edited by: Super
Date/Time: 2015-01-04 12:13:49

P 1: Interview1Dana
Codes: [ability to succeed]
one on one type of learning

P 1: Interview1Dana
Codes: [ability to succeed]
self-discipline; my husband and mom and they would give some words of encouragement

P 2: Interview2Jonathan
Codes: [ability to succeed] [Self-motivated]
I worked problems over and over til I felt comfortable with it.

P 2: Interview2Jonathan
Codes: [ability to succeed]
At first, I was still in my high school ways. I wouldn’t study that much I tried to put it off til the last minute. Now I keep my head in the books and study hard so I can make good grades.

P 3: Interview3Blaine
Codes: [ability to succeed] [Self-motivated]
You can ask your teacher about anything and you can take your tests as many times as you want to til you get a 80 or 70. I’m trying to get the highest score I can get.

P 4: Interview4Amy
Codes: [ability to succeed] [academic support]
If you really needed help they broke it down into steps where you could learn it. You will eventually learn it cause they’re really good teachers.

P 4: Interview4Amy
Codes: [ability to succeed]
do the work and the way the homework was is you could do it as many times as you needed to until you got it right.

P 5: Interview5Cheryl
Codes: [ability to succeed]
It was more from me. I wanted something better for myself

P 6: Interview6Wayne
Codes: [ability to succeed] [Self-motivated]
I was focused; I was driven

P 7: Interview7Peyton
Codes: [ability to succeed] [Self-motivated]
I push myself to the best of my abilities

P 8: Interview8Emma
Codes: [ability to succeed] [Self-motivated]
I’m hard-working, attentive, and prepared

P 9: Interview9Aaron
Codes: [ability to succeed] [Self-motivated]
I know what I have to do to be successful and I’m ready to get it done.