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COMPLETION AND SUCCESS OF COMMUNITY COLLEGE DEVELOPMENTAL STUDENTS ENROLLED IN ONLINE MATHEMATICS COURSEWORK

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ABSTRACT

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As online education gains popularity among both learners and postsecondary institutions, there is a movement toward identifying ways to promote student success. Over half of all higher education institutions offer online classes, due in part to the ease of offering and scheduling (Hoffman, 2006); educators seek ways to identify any demographic or academic characteristics that lead to success (Jaggars & Bailey, 2010). With the growth and popularity of online learning, postsecondary institutions must continue to develop best practices in the areas of online teaching pedagogies to promote student success. Within community colleges there is a growing acceptance of online courses and given that over 60% of incoming students test into developmental math coursework (Chen, 2016), answers must be sought to assist these developmental math learners toward online success. This study investigated the role of various student characteristics concerning student success in online developmental math course completion. The sample was students enrolled in a specific identified gateway mathematic course offered fully online in at a large suburban, public community college located in the northeastern part of the United States. Utilizing a mixed methods explanatory sequential design, explored course completion rates of developmental students enrolled in online college-level mathematics courses, the study analyzed the role

of demographic and academic characteristics for developmental students enrolled in a college-level mathematics course offered fully online from the fall 2017 through fall 2019 academic year. A second phase of semi-structured interviews was conducted to explore aspects of student success from individuals identified in the first phase. As the success of developmental college students is at the forefront of postsecondary institutions in their mission for student success online, the ability to identify characteristics that could lead to student success may assist in recommendations for online instructors and assessment of developmental math student college-level mathematics course completion.

DEDICATION

This doctoral journey and its result are in memory of my mother Patricia Josephine Smyth Ryder who taught me to reach for the stars and never stop till you achieve your dreams.

Her spirit and her grace have shown me that life is a gift and always worth any obstacles that are placed in our paths.

I will always remember her undying love and her zest for life.

Through the words of Patrick Henry:

I know not what course others may take, but as for me,

Give me liberty

Or give me death.

To my dear friends and family who have supported me along this journey, your friendship and love have sustained me and have assisted me through the doubts with laughter and joy.

To all the members of my cohort you may never know how much you all mean to me, but I wish you all success and happiness in life.

Finally, I dedicate this document to the students who shared their perceptions and all who pursue their educational dreams and excellence, may you be presented with educators and teachers that assist you in achieving your dreams.

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CHAPTER 1

Online learning and distance education have their origins in the days of correspondence courses, first offered in the 1890s as America looked to educate and train settlers in the agricultural knowledge that they required during the Industrial Revolution (Chaloux & Miller, 2014). Online learning has been defined by many as education delivered using technology with all contact delivered remotely. Most recently, Singh and Thurman (2019) identified online education as education being provided in an online setting using the Internet for teaching and learning. Within this definition, online learning is not reliant on a student's physical or virtual location, with its content provided online, and "the instructors develop teaching elements that enhance learning and interactivity in the synchronous or asynchronous environment" (Singh & Thurman, 2019, p. 302). The many iterations of this instructional modality led us to the format that students experience today, with essential elements that include technology, time, and synonymous periods. Identifying students' academic characteristics that lead to successful course completion in a college-level mathematics course online may assist postsecondary leaders to further support the needs of this student group completing coursework in an online modality.

Online education creates a physical separation of teacher and student (Kentnor, 2015) but its overall value has evolved as technologies now allow faculty more ways to connect with their students. Kentnor (2015) considered, "distance education began with correspondence and the use of parcel post, to radio, then to television, and finally to online education" (p. 21). In the United States, online learning has developed, with nearly 5.2 million, or 25% of all higher educational students, having completed at least one online class (Allen & Seaman, 2015). However, the exponential growth of the instruction

of online learning has also created disparity for students that begin college requiring developmental coursework (Coleman et al., 2017; Gaytan, 2013). The percentage of students requiring at least one remedial course between 2004 and 2009 stood at 68% of community college learners nationally (Chen, 2016). Despite this significant number of students requiring developmental curriculum and participating in online coursework, little research has been done to look at the modality of online learning regarding developmental mathematics students' persistence and success (Coleman et al., 2017; Gaytan, 2013; Thomas, J. L., 2016).

More than half of all higher education institutions offer online classes, due to the ease of implementation, as well as the flexibility of scheduling for both the learner and the institution (Hoffman, 2006). With the exponential growth and popularity of online learning and the reality that the online modality has become ubiquitous in institutions of higher education, institutions must continue to develop best practices in the areas of online teaching pedagogies and learning management platforms to promote student success. Community colleges are seeing a growth in acceptance of online coursework (Jaggars & Bailey, 2010; Thomas, J. L., 2016), as greater numbers of students are electing to take their required coursework in the online modality, leading institutions of higher education to offer more course sections within more disciplines. Online course developers continue to attempt to replicate the best practices of traditional classrooms. The modality of online asynchronous learning can be defined as flexible e-learning which is assisted by media such as e-mail and discussion boards that support work relations among learners and instructors, particularly when participants cannot be online at the same time. Many people take online courses because of their asynchronous nature,

allowing for the combining of education with work, family, and other commitments. The flexibility in asynchronous courses makes them manageable for students who have irregular schedules, as "Asynchronous e-learning makes it possible for learners to log on to an e-learning environment at any time and download documents or send messages to teachers or peers" (Hrastinski, 2008 p. 51).

Exploring the online course setting, this study examined community college students that previously required developmental math coursework, that opted to enroll in their first college-level math course online, and the academic and student characteristics potentially contributing to successful course completion. By examining the quantitative results derived from the sample and then exploring the existence of collaboration and engagement of these students in the online realm through a qualitative lens, the study set out to identify characteristics for successful online course completion of these community college students. Higher education community college faculty and leaders will continue to explore methods and designs in the online modality to achieve greater persistence and completion rates for their students. This study can inform postsecondary faculty and leaders of potential paths for successful course completion of previously identified developmental math students in their first college-level math course taken online.

Purpose of the Study

The purpose of this study was to investigate student characteristics contributing to successful course completion of community college students previously identified as requiring developmental math that participated in their first college-level mathematics course online. A mixed methods explanatory sequential design was used to collect and analyze the data. This two-phase study quantitatively investigated data from student

academic records to explore student success in online math coursework, then qualitatively investigated the findings, digging deeper to explore how collaborativism and engagement were used in this online environment. Creswell and Plano Clark (2018) explained that a mixed methods explanatory sequential design is the best method to provide a more detailed and contextualized analysis of data, drawing from both quantitative and qualitative information. The use of this method was to provide for a deeper, more robust, in-depth evidential basis by facilitating comparative analysis, culminating in the creation of narrative research. Mills and Gay (2019) explained mixed methods studies afford an understanding that is "both broad (i.e., from statistical results) and deep (i.e., from interview data) that is not possible to achieve using either a quantitative design or a qualitative design by itself" (p. 431). Studies that utilize this methodology can be more thorough and comprehensive than narrative studies containing only one design (Creswell & Plano Clark, 2018, p. 106). In the first phase, this study addressed the potential role of students' academic and demographic variables in their completion of college-level coursework. In the second phase, qualitative semi-structured interviews were conducted to explore students' perceptions of aspects of collaboration and engagement within online math coursework. The concept for the study was established to determine if specific student characteristics could predict success for previously enrolled community college developmental students within a college-level online mathematics course. The results of this mixed methods explanatory sequential design can be potentially used to forecast and improve community college student success of previously enrolled developmental mathematics learners that enroll to take their first college-level mathematics course in an online modality, and potentially provide

guidance for higher educational leaders in their capacity to garner success for these students.

Theoretical Framework

The education of developmental learners, identified as underprepared and requiring basic skills (Boylan, 2002; Chen, 2016; Lake, 2001), continues to be a principle in the mission and vision of community colleges (Cohen et al., 2014). However, the efficacy of developmental education, its cost, and the extended time to student completion that may deter student persistence have been the subjects of scrutiny.

Previous researchers have explored the demographic characteristics of gender, race, and socioeconomic status in association to retention, college success, degree attainment, and graduation rates of community college students (Bailey & Morest, 2004; Zeidenberg, 2008), as community colleges have higher percentages of first-generation, nontraditional, minority, part-time, low-income, and underprepared students (Aslanian, 2001; Cohen & Brawer, 1996; McCabe, 2000; Thayer, 2000); these characteristics can affect success for these students. How students enter post-secondary education and the extent of their preparation upon entry affects the courses that they are permitted to take and may pose an obstacle. Further research needs to be conducted regarding the developmental student and their paths to success.

The online delivery of mathematical instruction may not be the most suitable instructional modality for students needing developmental coursework, as these students can lack the preparation to appropriately succeed in an online environment to work independently on assignments, which could generate issues for persistence in coursework (Gaytan, 2013). Students enrolled in developmental math coursework may also be

deficient readers, easily overwhelmed by written instructions and details often found in online classes (Cross, 2009). The inclusion of developmental mathematics as students initially enroll in college greatly affects college success and graduation. These students must first successfully complete developmental mathematics course(s) where they are deficient to take subsequent community college courses to meet graduation/degree requirements (Bremer et al., 2013). Bissell (2012) explained that less than half of the high school graduates in the United States are ready to take college-level math courses. Additionally, Adelman (2004) estimated that 41% of students enroll in developmental coursework at some point during their college career. Community college students also conveyed that a difficult course such as those in the physical or life sciences was beneficial to take face-to-face, while humanities courses were preferred online. Additionally, Hyllegard et al. (2008) explained that at-risk community college students are attracted toward online courses with the thought that they are easier, or more convenient, only to discover them equally or more difficult. Online learning is a permanent and growing factor of community colleges; therefore, there exists the need for further research to identify characteristics for success, to assure that the developmental mathematics student will flourish and be successful in the online realm.

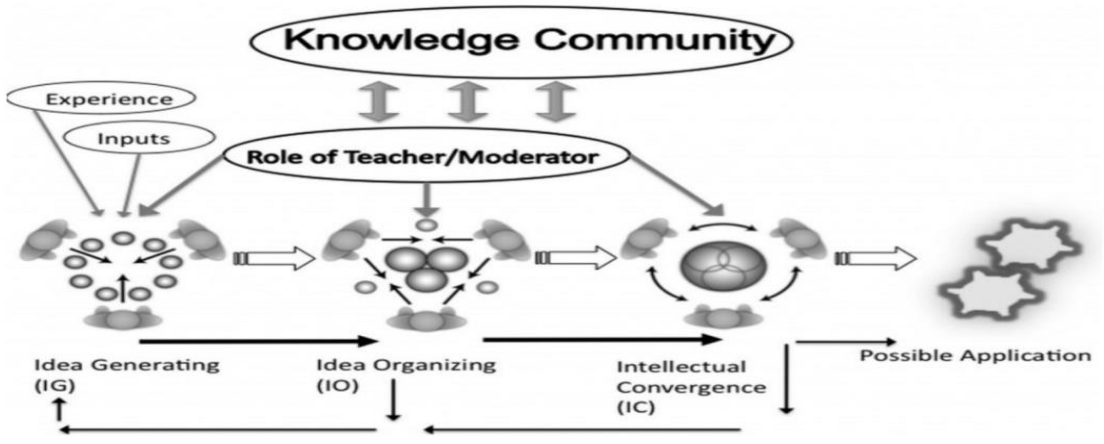
In choosing a theoretical framework for this study, it was important to recognize the underlying pedagogy of Online Collaborative Learning (OCL). The design of an online collaborative course is structured to provide opportunities for the students to construct or build knowledge as a group toward a common goal, which contrasts with cooperative group learning in which many students participate in individual parts toward the completion of an integrated project. When students work cooperatively, they are not

building knowledge but joining together independent pieces of self-achieved work, working independently on a part of a project to contribute to the final product. When collaborating, they are working collectively so that the final product is more significant than any one person could achieve alone (Harasim, 2017).

Harasim (2017) developed a theory of online learning known as OCL, referring to educational pedagogies that emphasize collaborative dialogue and knowledge, facilitated in an online platform. As observed "Collaborativism emphasizes processes that lead to both conceptual understanding and knowledge products" (Harasim, 2017, p. 117). This study explored through a qualitative narrative the concept that engagement, determination, and motivation of a student factor into the self-efficacy and persistence, as well as the inherent existing characteristics needed for successful course completion in the modality of online learning for developmental community college online learners.

Figure 1

Example Collaborativist Processes in a Class



Note. The collaborativist practice looks to illustrate the learning processes of online students consisting of Idea Generation (IG), Idea Organizing (IO) and Intellectual Convergence (IC). From L. Harasim, *Learning theory and online technologies*, p. 124. Copyright 2017 by Routledge.

Garrison et al. (2000) explained the Community of Inquiry (COI) as a foundation for establishing online learning communities; this learning pedagogy became an important tenet in the creation of a community of learners within the OCL theory. COI provides a practical capacity for creating and maintaining the collective learning character of traditional classrooms within a virtual environment. Garrison et al. (2000) first proposed their COI instructional model as the online environment of distance education began emerging in higher education. Swan et al. (2009) noted almost a decade later that COI offered a "pragmatic organizing framework of sustainable principles and processes for the purpose of guiding online educational practice" (p. 52). Since its beginning COI and its associated learning have influence and guided instructional design and distance education research that emphasized collaborativism, engaging theory in practice.

Harasim's (2017) OCL theory is the theoretical framework that was employed in this study to provide a structure for analyzing how developmental students engage and interact online and whether that engagement and interaction contribute to the learning and knowledge. As Harasim (2017) explained, "Collaborative learning recognizes discourse as the foundation of human learning and refers to ways of teaching and learning based on that discourse" (p. 121). In this process the learners advance from divergent thinking—the generating of many ideas, to convergent thinking—the narrowing down of the many ideas to a select few. Within the collaborativist learning theory one will find three key learning processes illustrated in Figure 1. Idea Generation (IG), the first step, is where the learners brainstorm, verbalize, and share thoughts with each other. By this exchange each member can discuss each of their ideas and hear those ideas of the other members. The

next step is Idea Organizing (IO). In this phase the learners begin to conceptually change in their thinking, challenging each other and beginning to converge in their thinking, selecting the strongest or best ideas. In this stage the learners engage in referencing, agreement, disagreement, and questioning. In the third step, Intellectual Convergence (IC), learners create a shared understanding by synthesizing their ideas and knowledge into clear points of view and positions, thus creating convergent thinking, as evidenced by shared product. In this study, I used these identifiable characteristics and indicators to examine the engagement and participation within the online learning modality necessary for developmental mathematics learners to be successful in their first gateway mathematics course online. The study examined if collaborative learning within an online course can assist both the success of the student and the learning attainment when implemented.

Significance of the Study

Community colleges nationwide experience substandard course completion, particularly within developmental mathematics cohorts (Chen, 2016). This detail, coupled with the online coursework format, can become an obstacle to student success. Much of the literature on online course completion has been derived from students in non-remedial coursework undergraduate populations attending college (Atchley et al., 2013). With a variety of factors that impact online student success at community colleges, it is critical to understand the reasons that students are not successful so that solutions may be identified. Community college students nationwide consist primarily of nontraditional students with an average age of 30 years old, mainly enrolled in part-time status, that spend little time on campus (Wladis et al., 2016). This creates students that are less

engaged on campus and participate less in the academic and student support services provided, producing a disparity in the understanding of what is required for them to be successful, particularly in an online class (Wladis et al., 2016). Nationally, over 68% of community college students enrolling in a 2-year institution are entering college requiring one or more remedial mathematics courses before they are permitted to begin taking credit-bearing courses, as developmental coursework is not inclusive in the core requirements toward a degree. These required classes add to the problematic issues surrounding retention and persistence (Jaggars, 2011; Shea & Bidjerano, 2018), by extending the path to degree attainment.

Hachey et al. (2012) discussed whether students are prepared, they often enroll in online classes believing that the courses will be easier, for reasons such as transportation and scheduling. However, background student characteristics of academic performance, lack of readiness, difficulties with technology, and lack of contact and connection with faculty and other students in an online course can lead to isolation, lower course success rates, and attrition for some online students. This isolation and not possessing academic readiness, coupled with the absence of substantial participation and engagement, leads to a lack of collaboration within the course. Without social, teaching, and emotional presence in an online course, students are faced with a significant barrier to success (Shea & Bidjerano, 2016; Garrison et al., 2000; Swan et al., 2009).

The National Association for Developmental Education (NADE, 2012) provides the following definition within the field of developmental education: Developmental education services within a community college generally address academic preparedness, assessment and placement, development of general and discipline-specific learning

strategies, and affective barriers to learning. Developmental education includes all forms of learning support, such as tutoring, mentoring, and supplemental instruction; academic advisement; personal, academic, and career counseling; and coursework (NADE, 2012). Shea and Bidjerano (2018) explored current research showing us that the methodology of the instruction may have an impact on the success rates of students. Their study explained that when non-remedial community college students take more than 50% of their coursework online, course completion rates drop to levels comparable to completion rates of remedial students, demonstrating that perhaps the modality of online learning, from the standpoint of the design and presentation of the materials, may not work for all learners.

Students entering community college seeking a degree or trade training are often juggling family, employment, and many responsibilities that compete for their attention. As many of these students are academically underprepared, these students face a further challenge in addressing the need for remediation in addition to the standard stressors. With the time constraints and responsibilities these students possess they look to the modality of online learning, believing that they do not need to physically attend classes face-to-face which will assist them in academic success. This belief of students does not always hold true, as research shows that students attempting online learning, entering college academically underprepared, are far less likely to be successful.

Menchaca and Bekele (2008) in their study of success factors of both learner and instructor recommended that the quality and environment of online collaboration further be examined to develop methods for supporting student achievement. Oncu and Cakir (2011), in their study of priorities and methodologies for online learning, found that developing reliable and valid student assessment techniques for online learning

environments was critical to measuring student achievement and engagement. Their study examined the significance of collaboration as a key for learning. The subject of OCL has focused on new designs for learning, but limited studies have been conducted to assess these new learning designs. There is little known context for judging what is best practice in assessing collaborative discourse (Oncu & Cakir, 2011).

To fill these gaps in the literature, this study examined the collaborative process utilizing Harasim's OCL theory to assess. Studies examining OCL designs are critical given the ongoing perceptions of the quality of online education. As concerns about the success of developmental college students are at the forefront of postsecondary institutions, the ability to identify characteristics that could lead to student success may assist. The results of this study can lead to recommendations for online instructors through evaluation of previous developmental math students' success in a college-level online math course.

Connection to Vincentian Values and Social Justice

This study ties to the Vincentian values of the freedom to pursue education and learning. As the mission of this community college is to provide educational opportunities for all, not dependent on ability nor on economic status, it emulates the Vincentian tradition of looking for causes of poverty and social injustice while providing solutions through education and training. By seeking pathways to assist developmental students to achieve success in an online modality, this study can provide potential solutions for these students to succeed.

Quantitative Research Questions

Given the increased prevalence of online learning within community colleges, it is essential to explore student success for previous developmental mathematics students enrolled in online coursework to ensure that the outcomes for these mathematics students are met. As such, the research questions guiding this study are:

1. What is the predictive influence of demographic characteristics of age, gender, ethnicity, and socioeconomic status on successful course completion of developmental students enrolled in a college-level online mathematics course?
    - Hypothesis H_0: Age, gender, ethnicity, and socioeconomic status have no predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.
    - Hypothesis H_1: Age, gender, ethnicity, and socioeconomic status have a predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.
2. What is the predictive influence of academic characteristics of successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded on successful course completion of developmental students enrolled in a college-level online mathematics course?
    - Hypothesis H_0: Successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded have no predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.

- Hypothesis H_1: Successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded have a predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.

Qualitative Research Question

The qualitative research question guiding this study is:

3. How do students enrolled in a fully online mathematics course describe their participation and engagement within this course?

Definition of Terms

Academic Characteristics:

Variables developed once a student commences coursework within an institution that affect student learning needed for student success in college-level coursework.

College-level Mathematics Course:

The first credit-bearing mathematics course taken by a student who successfully fulfills the requirements within developmental math.

Course Withdrawal:

Leaving a course before grading has been completed.

Developmental Coursework:

Remedial noncredit-bearing courses offered as necessary to advance knowledge, required for a student's deficiencies in college entrance standards; these courses are not included in core coursework toward degree.

Learning Communities:

A form of collaborative learning that serves as a program where the three major forms of educational collaboration are found: collaboration between students, collaboration between teachers, and collaboration between student and teacher (Cuseo, 1982).

Nontraditional Students:

Students with an average age of 30 years old, mainly enrolled in part-time status, that spend little time on campus (Wladis et al., 2016).

Online Course Completion:

Completion of the course with a grade letter earned, exclusive of withdrawal and incomplete designations.

Remedial Coursework:

Educational programs designed to assist students in reading, writing, and mathematics (Ulmer et al., 2016).

Successful Credit Hours Completed:

The total completed credit hours, categorized by the number of credits successfully completed with a passing grade of C or better.

Successful Online Course Completion:

Passing an online course with a grade letter of or better.

CHAPTER 2

Community college create an accessible postsecondary choice for a group of students with diverse needs. Many community college students attend classes and study while employed; caring for others; and managing academic, personal, and financial challenges (Center for Community College Student Engagement [CCSE], 2012). The 2011 Community College Institutional Survey (CCIS) reported that 67% of full-time students and 78% of part-time students work at least part-time while completing courses, and 53% of full-time students and 60% of part-time students reported caring for dependent children or parents (CCSE, 2012). As tuition for community colleges is moderately low, these institutions are seen as pathways to postsecondary education for financially lacking and minority students (Arendale, 2010; Bantum, 2013; Boggs, 2011; Hagedorn et al., 2002; Mendoza et al., 2009; Roksa, 2010). In recent years tuition rates for community colleges have been increasing as these college budgets are straining to stay steady due in part to decreases in federal aid, unreasonably affecting students of lower socioeconomic status who are more inclined to attend community colleges (Mendoza et al., 2009). Given that the research shows that ability to pay has been found to be associated to college persistence (Arendale, 2010; Bantum, 2013; Boggs, 2011; Dowd & Coury, 2006; Hagedorn et al., 2002; Mendoza et al., 2009), the cost of education has a substantial effect on student selection to enroll and the ability to afford has shown an influence on college persistence (Arendale, 2010; Carter, 2006). The socioeconomic level of the student is directly related to retention, and financial aid can play a significant role in recruitment, retention, and graduation for minorities, low-income students that

often depart college if they do not receive enough financial aid through grants, loans, and work-study (Seidman, 2005).

A sizable difference exists between the percentage of community college students who attempt to complete a degree and the percentage of those who actually do. Research shows student persistence from freshman and sophomore years at public community colleges in the United States ranged between 51% and 53.7% which illustrates a significantly lower persistence rate than the 68% persistence rate at 4-year public institutions and the national average 65.7% for higher education in 2008 (ACT, 2008). Less than half of incoming community college students that communicated a goal of earning a degree or certificate met their objective within 6 years after beginning college (Crosta et al., 2006). Additionally, minority students make up 33% of the enrollments in 2-year institutions (Ryu, 2008). Entering students from ethnic minority backgrounds are more likely to enroll part-time and are more likely to come from families of lower socioeconomic status (Bantum, 2013; Fike & Fike, 2008), a factor in many studies to be related to lower retention and graduation of these cohorts (Adelman, 2006; Bailey et al., 2008; Bantum, 2013; Crosta et al., 2006). As many of the students that attend community college come from all socioeconomic and academic levels, and face numerous personal challenges, the ability to support these students in retention and success is in many cases unachievable (Adelman, 2006; Bantum, 2013; Boggs, 2011; Pascarella & Terenzini, 2005). In their study, Fike and Fike (2008) examined predictors of fall-to-fall and fall-to-spring retention for 9,200 first-time community college students first enrolled at the institution during the fall semester during 2001−2004. Their study identified unique

qualities of community college students and assessed the impact of these characteristics on community college student retention.

Tinto (1999) observed that postsecondary institutions do not adequately emphasis the effect of incoming characteristics on student retention. Bean's (1990) student attrition model, founded in psychology, claimed that the setting and a student's background determine whether they persist. Astin (1991) conceived the input-environment-outcome model that enumerates that the outputs in education (e.g., credentials earned, number of graduates) is assessed according to the comparable educational inputs (e.g., gender, age, student ability, major, etc.). Community college students' unique characteristics provide an area of inquiry that had not been represented fully by traditional retention theorists (Fike & Fike, 2008). Community colleges have higher percentages of first-generation, nontraditional, minority, part-time, low-income, and underprepared students (Aslanian, 2001; Bantum, 2013; Boggs, 2011; Cohen & Brawer, 1996; McCabe, 2000; Thayer, 2000; Thomas, J. L., 2016). Chickering and Reisser (1993) are among many academics who have recognized that students entering postsecondary education believe that they can reach their academic goals, but their perceptions and the reality of achievement often clash.

Theoretical Framework

Researchers have proposed that based on different learning theories students online can struggle in part to the lack of social atmosphere found in a traditional classroom that may be missing online (Breen, 2013; Sargeant et al., 2006; Harasim, 2017). In examining student learning through the lens of social theory, researchers have found students learn through collaboration and reflection. Constructivist theory implies

that these interactions create importance and comprehension (Sargeant et al., 2006; Harasim, 2017). As students in an online environment must possess self-motivation, many developmental students use great determination to complete their coursework. Traditional face-to-face classrooms have historically been instructor focused, but online classes, particularly in an asynchronous format, often demand more self-determination from the student. Jaggars (2011) enumerated and showed in her study that the increased social distance between the instructor and the student was a disadvantage to student success in online courses. The self-discipline and structure required for a student to be successful online is beginning to be identified as a concern as it pertains to developmental students, since many developmental students struggle to maintain structure and self-motivation (Boylan, 2002).

Harasim (2017) explained that collaborativism, or OCL theory, refers to educational pedagogies that emphasize collaborative dialogue and knowledge reasoning facilitated by an online platform. As Harasim observed, “Collaborativism emphasizes processes that lead to both conceptual understanding and knowledge results” (p. 117). Within the qualitative portion, this study explored the concept that participation, engagement, and motivation of a student will factor into the self-efficacy and persistence in the modality of online learning for developmental community college learners online. In examining these students’ perceptions of their participation and engagement online, this study first quantitatively explored the correlations existing of demographic characteristics of age, gender, ethnicity, and socioeconomic status with the academic characteristics of successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded to identify necessary for student success

online. Next, this study took a qualitative approach to ascertain the students' perceptions of the existence of participation, engagement, and motivation in an online learning modality and its contribution to student success. Harasim's OCL theory, also known as collaborativism, is the conceptual lens through which the study analyzed the literature on the platforms of online pedagogies of engagement and collaboration to achieve student success in an online course.

Specific to this study, this theory of collaborative learning can be the single most important concept for online learning since this principle adopts the strong social and academic power of learning online. The asynchronous methodology of online learning both supports and involves collaborative learning: collaboration provides the environment of a community that encourages learners and influences them to participate. Collaboration allows for students to work together to accomplish shared goals; individuals seek outcomes advantageous to themselves and to the other members of the group. Collaborative learning is the instructional methodology of small groups so that students develop their own and one another's learning. In collaborative learning activities, there is a positive interconnection among students' learning; learners perceive that they can reach their goals if others in the class also do (Breen, 2013; Johnson & Johnson, 1989; Harasim, 2017). Collaborative learning is based on a concept that has been investigated by numerous research studies and explains a modality of learning, utilized at any level of education. Communication is an intellectual act in which the student presents, supports, develops, and refines ideas. To articulate their beliefs, students must organize their thoughts and knowledge to be able to engage in learning. Active learner participation leads to multiple perspectives on issues, difference of ideas and

positions that student must classify through to find meaning and convergence. The growth and development of problem-solving skills depends on an individual being questioned, whether by self or others (Breen, 2013; Johnson & Johnson, 1989). It is through this online collaboration that students encounter opportunities regarding solving academic questions through the online environment.

Engaging learners in a shared pursuit for knowledge requires that instructors embrace new methodologies and roles. Collaborative courses must utilize modalities that engage and establish the attribute of teaching presence where communication and teamwork create a sense of community; instructors must be trained to moderate, mediate, and facilitate discussion virtually. Course design is central to the establishment of social collaboration and integration among community college students in online courses. In fact, one of the frequent findings from the literature reviewed is that students attain greater success in online courses that have been well designed and reasoned out (Bork & Rucks-Ahidiana, 2013; Jaggars & Xu, 2016; Liu et al., 2009; Lokken, 2016; Simunich et al., 2015; Thomas, J. L., 2016; Tirrell & Quick, 2012). Yet, quality design takes time and effort to achieve. Establishing engaging and effective online courses is no small task, especially for community colleges that have scarce resources. Creating engaging and dynamic platforms require many hours of development, which is particularly difficult for adjunct faculty who often reveal feeling separated, unsupported, and detached themselves (Breen, 2013; Jolley et al., 2014; Thirolf, 2012). Designing successful online courses requires experienced faculty, faculty resource centers, up-to-date technology, and a supportive administration (Johnson & Berge, 2012). Yet, community college administrators report scarce resources, support staff, and student services for online

students as some of the greatest challenges to a student's success (Lokken, 2016). Community colleges, looking to increase their online offerings, must utilize effort to ensure that courses are designed effectively, and instructors are clear in their expectations (Bork & Rucks-Ahidiana, 2013), and students must be provided with learning modality support (Lokken, 2016; Thomas, J. L., 2016). Community colleges must also make sure that instructors teaching online courses are sufficiently trained and ready for the unique challenges that come with teaching at a distance (Johnson & Berge, 2012).

Garrison et al.'s (2000) COI will also be applied when exploring communities of online learners within the online community. COI provides a practical opportunity for creating and maintaining the collectively established character of traditional classroom learning in a virtual environment. Garrison et al. (2000) proposed their COI instructional model as the online environment of distance education began emerging in higher education. As a "pragmatic organizing framework of sustainable principles and processes for the purpose of guiding online educational practice" (Swan et al., 2009, p. 52), the COI and its learnings have influenced and guided instructional design and distance education research that emphasizes theory's implementation in practice.

Studies have shown that persistence, transfer, and completion rates in 2-year community colleges are low, and only a small percentage of students who enroll in one of the nation's community colleges will succeed in their goals once enrolled. The challenge for officials and leaders of these institutions is to improve the student outcomes to fulfill the promise of the community college institutional mission. There is no doubt that community colleges, in their pursuit to increase student access and to make the most effective use of the scarce resources available to them, will continue to depend on online

instruction. As was previously discussed, community colleges enroll more students in online courses than does any other segment in higher education (Allen et al., 2016; Lokken, 2016; Thomas, J. L., 2016). But there are many important questions regarding the efficiency of online instruction in helping community college students achieve the goals necessary for success, even as calls for increased dependence on online learning are made.

Mission and Background on the Role of Community Colleges

The unique formation of community colleges plays an important role in the higher educational landscape. As of fall 2015 they numbered 920 (19.9% of all degree-granting postsecondary institutions) and were the source for enrollment of 6.2 million students (30.4% of all degree-seeking students) (National Center for Educational Statistics, 2017). Community colleges create an attainable path for many to pursue a degree or certificate within higher education. As a critical key player in post-secondary education, the community college has become a pathway to baccalaureate degrees, career and technical education, and developmental education (Cohen et al., 2014). With the evolution of higher education in the past 100 years, the role and mission of the community college has changed to the model that we know today. Just as the purpose of community colleges has changed since their inception, we have seen the continual shift in the missions and visions of community colleges also. Having evolved primarily as a source of the first 2 years of a baccalaureate education prior to transfer into a university, they have transitioned to the model we have today (Boggs, 2011; Cohen et al., 2014; Grubbs, 2020). To understand the distinctions that are unique to the community college, one needs to examine the environment that these institutions have operated within, both past

and present. Frye (1993) identified that the history of community colleges in the United States began very simply as an extension of the K–12 journey for those students that were unable to attend the limited number of higher educational institutions available. Ratcliff explained that the first public junior college developed because of distinct social and economic forces produced by the second industrial revolution beginning in 1870s into the 1920s (Ratcliff, 1987). A primary mission of community colleges is the education of students in general coursework often called liberal arts, to assist students in preparing to transfer to a 4-year university; this is still integral to the mission of community colleges today (Boggs, 2011). Yet, community colleges provide an entry path into higher education for many who may not otherwise seek a postsecondary education (Cohen et al., 2014; Thomas, J. L., 2016). Students that are seeking certifications and those needing remedial assistance find their way to the community college. Initially, the primary mission of a community college was to provide access to a postsecondary education to all. As the educational needs of communities began to change, the mission and visions of these postsecondary institutions developed two additional paths: the attainment of career training, which allowed for entry directly into a career path, and the realization of remedial educational, which can open the door for further educational instruction, thereby assisting developmental students in their journey toward a higher educational degree (Boggs, 2011; Meier, 2013; Vaughan, 1991).

After the second industrial revolution the emergence of career and technical programs, with the development of certification and degree attainment in the trade fields, became a mission for the community college. These certificate degrees as well as noncredit remedial programs became needed to assist returning veterans and others to

enter the career force immediately (Cohen et al., 2014). In developing certificate and degree training programs, community colleges looked to augment them with coursework in the liberal arts, thus adding to the enrollment in courses that provided a technical or occupational skill, able to assist the student in a straight path for employment. These career and technical programs were well received and created immediate growth for community colleges, as well as assisting the society in trained labor and the creation of necessary jobs.

Community colleges offer many of their associate degrees and certificates in occupational studies. In 2013, 67% of their programs were accessible due in part to the open-door policies that are a main tenet of the community college (Dougherty et al., 2017; Thomas, J. L., 2016). These certificate programs, as well as pre-college or developmental education, became a key component of the community college's mission. One that was brought into emphasis only after the community college's commitment to open access, opened the door of higher education to those portions of society lacking the academic prerequisites for college-level work (Vaughan, 1991).

At the center today of the mission of the community college lies its commitment to the communities in which they serve; in most instances this commitment extends beyond the academic domain to the development of both the economic and social one. Boggs (2011) asserted that community colleges contribute to the financial outlook of the communities that they serve by providing trained labor for businesses and personal growth for citizens with the offering of noncredit courses in areas such as ESL, community service, and remedial and professional development. These noncredit courses

were estimated in 2007 to be offered to 5 million students throughout the United States (AACC, 2010).

As each of these missions differs in its necessities for students, it creates a widening of the mission and visions for community colleges. Community colleges in the United States have become more willing to venture to the margin of their mission and once there, develop courses and programs addressing the greater needs of society, and fulfill the needs for local community and its employers (Boggs, 2011). Studies have also shown these training needs have traditionally been ignored by much of the rest of higher education (Vaughan, 1991).

Boggs (2011) explained that one of the primary characteristics of community colleges is their wide-ranging missions that offer the following: access and inclusion, community responsiveness and innovation, small class sizes, and focus on instruction. All these areas that make up a community college, along with their focus on investment in the communities in which they operate, create the community college that we know today. Since 1983, when the U.S. Department of Education under President Ronald Reagan established the National Commission on Excellence in Education to oversee a study of the U.S. education system, our executive leaders have been focused on increasing the educational level of our country to become more competitive with other countries. For the next two decades the U.S. government sought ways to increase the educational attainment of higher education students while concurrently attempting to assess what was needed to help them succeed. In July 2009, President Barack Obama charged higher educational institutions and their leaders with the American Graduation Initiative: Stronger Skills Through Community Colleges (AGI). This program was

designed to have community colleges prepare an additional 5 million graduates and program completers by 2020, adding an additional 50% to the current level of college educated citizens (Boggs, 2011).

The community college's major contribution, then, lies in its interaction with the larger society, an interaction that requires a relatively stable core and an ever-evolving edge, that requires leadership to identify community needs and to resolve those needs through its mission as an educational institution (Vaughan, 1991, p. 10). Numerous studies have looked at the success of community college students; most of these studies were intended to identify academic and student characteristics that will assist higher educational leaders to perhaps determine factors that will assist community colleges with retention and persistence. Braxton et al. (2011) identified 16 propositions that create a foundation for the development of a theory accounting for community college student departure with the "The basic elements of this theory of student departure; include student entry characteristics, the external environment, the campus environment, and the academic communities of the institution" (pp. 42–43). As research has shown, the characteristics of student entry, motivation, control issues, self-efficacy, empathy, affiliation needs, parental education, and anticipatory socialization all affect a community college student's ability to persist and ultimately achieve success (Braxton et al., 2011; Breen, 2013).

Higher educational institutions, including community colleges, need to better support the development of the skills and academic characteristics that their students need to acquire, so that these students will be successful. Braxton et al. (2011) explained that a significant role in the departure cycle is demonstrated by student entry characteristics

within community college groups. They discussed that entry characteristics such as family background, academic ability, and high school academic achievement all affect the level of commitment. They observed that the addition of encouragement by a significant other affect and assists student adjustments to both the external environment and the environment of the commuter institution. The external environment adds many dynamics to the equation when analyzing areas of stress and obligations for these students. The campus environment of a community college is fashioned by the students that attend it. The transient nature comes from the characteristics of the students in attendance as they spend little time in the creation of social networks, which adds to the risk of departure (Tinto, 1993). The formation of academic communities has been noted as an important aspect of learning (Braxton et al. 2011).

Online Learning Use in the Community College Environment

Atchley et al. (2013) addressed the growing enrollment of online courses which are outpacing their face-to-face counterparts. The modality of online course offerings is an area that leaders of higher education are looking at to counter the decreasing enrollment of traditional learners in the face-to-face modality. The research as to whether the modality of online is a good fit for all postsecondary learners is one that is new and needs to be explored further regarding student success. Atchley et al. have noted the new issues that have arisen: “With the growth of online course enrollments, questions have been asked about course completion and student performance in online courses compared to traditional, face-to-face courses” (p. 105).

Student academic performance and course completion, when examined for those enrolled in fully online courses, show that the performance of students in this online modality to have significantly positive performance by course discipline.

The existing research highlights inconsistencies in completion rates that suggest students drop their online classes because they feel isolated from a lack of contact with their peers and instructor (Bambara et al., 2009; Beatty-Guenter, 2003; Breen, 2013; Jaggars, 2011; Kaupp, 2012; Swan et al., 2009). Some studies suggest the lower completion rates can be attributable to negative self-selection affecting student performance (Carr, 2000; Huntington-Klein et al., 2015). Hyllegard et al. (2008) posited that at-risk community college students are attracted toward online courses with the thought that they are easier, only to discover them equally or more difficult. Hachey et al. (2014, 2015) found that, in addition to overall grade point average (GPA), students' completion grade in a previous online course was the greatest predictor of future online course completion. Therefore, there appears to be the potential that students at academic risk who enroll in online courses have reduced probabilities of success, which in turn further reduces their chances of subsequent online course success. That said, Johnson and Berge (2012) argued that comparing course completion rates in online and face-to-face courses may come down to operational definitions of success and failure. Johnson and Berge noted in some cases older working students simply wanting to gain a set of skills, without necessarily completing the course, may consider failing to complete an online course not actually a bad thing.

Studies examining whether students who take classes online are more or less likely to attain awards such as a certificate or degree are few. The existing body of

literature focuses on the impact of online learning on persistence and transfer, and the conclusions of the limited studies around online learning and program completion are mixed. In their analysis of community college students enrolled in Washington State, Huntington-Klein et al. (2015) reported that students who elected to take an online course over a comparable face-to-face course showed lower retention and degree completion rates. Comparably, Jaggars and Xu (2010) and Xu and Jaggars (2011) described robust negative associations between taking online courses and later receiving an educational degree. Conversely, Shea and Bidjerano (2014, 2016) discovered that students who completed at least one online course in their first year of enrollment were significantly more likely to earn a degree after 6 years. Utilizing the same data and similar methodology as Shea and Bidjerano (2014), Sublett (2018) discovered that community college students who elected to take online courses in their first year ultimately completed their BA degrees roughly 3 months earlier than students who did not. Johnson and Cuellar-Mejia (2014) reported that while overall California community college students were less successful in their individual online courses, those students who enrolled in online courses were more likely to earn an associate degree or to transfer to a 4-year school compared to similar students who never enrolled in online courses. When we read the research on the diverse results of community college students enrolled in online courses, it appears more research is needed in this crucial area, to address the paradox surrounding success and the taking of online coursework.

Developmental Learners in the Community College Environment

Underprepared students have always been part of higher education, beginning in the first American institution of Harvard, in 1636 (Boylan, 2002; Bontrager, 2015;

Thomas, J. L., 2016). Tutoring programs were established as there was a prerequisite to teach Latin and Greek to untrained students (Arendale, 2010; Casazza, 1999). Since then, support programs, and curriculum changes have been established in institutions to better prepare their students for success for in college. It can be noted that in the beginning these developmental students were mostly wealthy White students who departed little in the services that they required (Arendale, 2010). Providing remediation eventually extended to other colleges and institutions eventually encompassing all American schools. As the number of institutions offering developmental services increased, so did the admittance of underprepared students (Bahr, 2010; Thomas, J. L., 2016).

During the Jacksonian Democracy, developmental students increased in number as the education of the middle class and technical career training became a priority of the United States (Boggs, 2011; Boylan, 2002; Thomas, J. L., 2016; Van Deusen, 1992). The Jacksonian Democracy was an undertaking based on the advancement of the common man which looked at education as a way of equalizing aspects of class through education. It created educational opportunities to an increasing number of citizens, ultimately giving all access to education. Colleges in the early 19th century were mainly self-sustaining operations, so anyone who could afford the cost of attending college was accepted. Underprepared students were admitted in part for the following reasons during the 19th century: (a) colleges needing the revenue required to operate, (b) the number of institutions exceeding the number of equipped students, (c) the belief by many in higher education in the Jacksonian ideology of providing educational opportunities, and (d) as the need that as college programs changed, so did prerequisite skills. Yet, as early as 1828, there began an action to campaign for an end to the admission of students with

inadequate academic preparedness. Eventually this movement was countered by the growing higher educational campaign toward educational equality (Bahr, 2010; McLaughlin, 2010; Vossoughi, et.al, 2016). As the establishment of colleges throughout the U.S. began, the lack of a standardized system of secondary education was revealed (Casazza, 1999).

The Morrill Act of 1862, also known as the Land Grant Act of 1862, began the escalation of the number of underprepared students attending colleges, forcing these institutions to seek solutions to address the challenges posed by their admission (Goodchild & Weschler, 1997). As the establishment of these land grant institutions exposed a secondary school system that was inadequate to support the enrollment needs, these higher educational institutions found it necessary to create and establish programs to develop the necessary skills for incoming students to be successful in college-level coursework.

With the introduction of the GI bill of 1944, there began an intensification in the number of students heading to colleges to seek career and technical training for entry into the workforce. With the introduction of the Higher Education Act of 1965, the creation of open-door policies of community colleges were being seen. This higher educational policy created funding that allowed many students to pursue college for the first time (Goodchild & Weschler, 1997). As students of all skill levels began to enroll, some of these students lacked the basic core curriculum background needed to succeed. The creation of laws such as the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Act of 1990 opened higher educational access to even further to students from all skill sets and knowledge levels. Higher

education began the task of establishing departments to meet the needs of students with disabilities and of minority students, increasing the motivation to create programs aimed at success for students with special needs and multicultural backgrounds (Bahr, 2010; Goodchild & Weschler, 1997).

Developmental education has grown through the years to the create the form that we see today. Developmental education today takes many forms, whether it is a course, a program, a service, or systematic support to assist today's distinctive learner (Casazza, 1999). Developmental education includes more than first year services provided to students; it encompasses all levels of education. Services including tutoring, study skill development, and critical thought (Bahr, 2010; Casazza, 1999; Payne & Lyman, 1996; Thomas, J. L., 2016). The developmental learner can be defined as underprepared and requiring basic skills in many areas due to an open admission system (Boylan, 2002; Lake, 2001).

Demographic variables such as characteristics of gender, race, and socioeconomic status are associated with retention, college success, degree attainment, and graduation rates of community college students (Bailey & Morest, 2004; Zeidenberg, 2008). Various issues other than demographic characteristics have been identified as problematic with respect to success for these students. As students enter post-secondary education, their lack of preparedness when entering may be an obstacle. In 2004, in was noted that 50% of all first-time community college students needed developmental education in English, math, or reading (Marti, 2008; McClenney, 2004). Research has shown that proper academic support and instruction can be effective in assisting students to overcome weaknesses in their pre-college academic groundwork (Pascarella & Terenzini, 2005).

Developmental education interventions promote underprepared students' achievement and persistence in both the short term—a student's first semester, and in the longer term—assisting students to degree completion (Bahr, 2010; Boylan et al., 2005). As interventions are essential for beginning community college students, it is crucial that community colleges offer developmental education. McClenney (2004) explained, "The truth of the matter is that if students don't succeed in developmental education, they simply won't have the opportunity to succeed anywhere else" (p. 16).

Developmental Math Coursework

Mathematics education is important for student success in post-secondary coursework, not only for the societal need, but also for the individual, as it offers a greater number of college and career choices (U.S. Department of Education, 2008). As post-secondary students within the United States struggle in mathematics, community colleges across the nation experience low levels of student success in developmental math courses (Bahr, 2010; Bontrager, 2015; Gerlaugh et al., 2007). The outcome of these developmental math courses can greatly affect college success and graduation, as students must first successfully complete developmental mathematics course(s) to take successive community college and/or college courses (Bremer et al., 2013). Bissell (2012) detailed that less than half of the high school graduates in the United States are prepared to take college-level math courses. Additionally, Adelman (2004) assessed that 41% of students enroll in remedial courses at some point during their college enrollment. The intention of developmental math courses is to assist students in preparation for college-level math work, yet they can be viewed as a barrier for students. Completing these remedial level courses can be a significant indicator for success, for if students are

unable to complete college-level courses they will be unable to attain a college degree (Bahr, 2010; Bontrager, 2015; Daugherty et al., 2013). With these facts, some students may be unable to achieve their educational goals, because they fail in these developmental math courses.

Post-secondary students in many cases are required to take a placement test when entering, and dependent on their score many are required to take developmental math coursework (Blum et al., 2007). Most colleges include in their developmental math program a sequence of two or more levels of remedial math coursework, beginning with arithmetic and ending with introductory or intermediate algebra (Blum et al., 2007). The longer the developmental sequence, the greater the chance the student will not complete the succession, and the greater the chance of the student will leave without earning a degree (Asera, 2011; Bahr, 2010; Bontrager, 2015). Usually, these developmental courses do not weigh toward college credit, but "are prerequisites for credit-bearing math courses and most degree-granting majors and programs" (Blum et al., 2007, p. 2). Therefore, the students being placed into remedial coursework experience longer time and greater expense to degree completion.

A mission of community colleges is to provide efficient instructional methods to underprepared students (Bahr, 2010; Bontrager, 2015; Holt et al., 2012). While it would be assumed that developmental education would benefit all students equally, studies have shown that there are substantial racial differences (Bahr, 2010). Blacks and Hispanics are proportionately disadvantaged in math achievement and earn low grades in remedial courses (Bahr, 2010). While developmental math courses were created to help students succeed, some research shows they may have become obstacles for successful completion

of coursework and degree attainment (Bahr, 2010; Bonham & Boylan, 2012; Bontrager, 2015). Low-income, African American, and Hispanic students are more likely to need developmental math courses and are also less likely to succeed in these courses. Furthermore, historically disadvantaged students make up the largest percentage of students who begin college in the lowest remedial sequence (Bahr, 2012b).

Gerlaugh et al. (2007) discussed in their study of 5,000 developmental students at 116 universities found that while retention rates in developmental math courses were 80%, only 68% earned a grade of C or better and, of those, only 58% of developmental math students passed their first college-level math course. For students who finish successfully in community college developmental math courses, research has verified that these students show academic achievement comparable to nonremedial students (Bahr, 2008; Bahr, 2010; Waycaster, 2011; Whaley, 2015). In other words, there appears to be no academic difference between students who previously took a developmental math course and those who did not, in their subsequent college-level math course achievement (Bonham & Boylan, 2012; Bahr, 2010; Bahr 2012b; Bontrager, 2015;). Bachman (2013) sought to understand students' perception of remedial education, finding that some students favored the benefits, while some students reported remedial education as being unwanted and that they experienced initial embarrassment and anxiety having to take the course.

Colleges regard remediation as required because incoming freshmen are not reaching college-ready levels on national assessments. The term "remedial" is interchangeable with "developmental" and "basic skills" (Bautsch, 2013). Watanabe

(2016) cited a study performed by the Public Policy Institute of California (PPIC) saying the following:

> Eight of ten community college students are placed into remedial classes to gain college-level skills before moving to courses that count for credit. Only 16 percent of those students earn a skills certificate or two-year degree within six years, and just 24 percent transfer to a four-year university. (para. 2)

The rate at which remedial students successfully complete their college-level math requirements or even achieve degree completion is profound (Bahr, 2010; Bahr, 2012a): of all community college students assigned to remedial level math, almost two-thirds fail (Kirp, 2017).

Remedial classes are comprised of coursework taken on a college campus that are below college level assignments. Full tuition is paid for remedial courses, and these classes do not receive credit toward graduation. Many students are simply discouraged when they are informed that they are not eligible for college-level courses. Discouragement and lack of motivation results in high "no-show" rates among developmental students in attendance (Bailey & Cho, 2010; Bahr, 2010; Whaley, 2015).

Remedial-level classes present a challenging hurdle many for students. Taxpayers and states spend millions of dollars on remediation, but students shoulder the most significant costs, in terms of tuition dollars and time spent on courses that do not count toward credits necessary for graduation. Semesters wasted in remedial courses delay a students' progress through college and ultimately may cause them to not complete their degrees (Chen, 2017). Studies have shown students who successfully complete developmental mathematics are more prone to catch up with college-ready peers and yet

failing a developmental mathematics course is associated with significant negative outcomes (Fike & Fike, 2008).

Waycaster (2001) noted the effectiveness of developmental courses in mathematics to prepare students for college-level work and the efficacy of different pedagogical methodologies in the developmental mathematics classroom discovered students that took remedial coursework were equally as successful as those that did not. Waycaster (2001) explained that between 56% and 81% of the students regularly attended classes in the beginning of the semester, but this percentage sharply declined, often to single digits, at the end of the semester. Additionally, attendance was a problem in the classes that had pauses when students did not return for the second half of a class. In developmental courses, success is adequately met if completion rates are between 61% and 70% (Roueche & Roueche, 1993).

Increased government requirements are driving community colleges to redesign developmental mathematics sequences. Faculty endeavor to maintain academic control in an area they are guarding from government influence and institutional control when administrators attempting to impose drastic changes to pedagogy and methodology. Higher educational leaders place responsibility on faculty to create methods in which the time students spend in remediation is accelerated and compressed, drastically reducing time to degree. Compressed courses can allow post-secondary students the capability to complete multiple developmental courses within one semester (Edgecombe, 2011). As traditional developmental mathematics sequences may require students to enroll in stand-alone courses, one at a time, over the course of their academic careers. Compressed coursework permits students to take multiple classes and complete developmental

sequences in arithmetic and algebra in less time (Cafarella, 2016). Accelerated courses are a change to learning pedagogy, through which the reorganization of learning outcomes allows students to complete developmental courses in an advanced method. This type of modality is often presented in an online setting, where students use a program with self-regulated lectures, exercises, and assessments. Policymakers and higher education administrators are continually seeking to save students time and money on courses they perceive to be effective. Higher educational leaders are understandably frustrated with the number of students who require developmental mathematics and do not complete college requirements in a timely fashion (Mangan, 2014).

Remedial math, reading, and writing courses provide an advantage to society, by providing a path to economic stability and freedom for individuals lacking certain competencies and skills (Day & McCabe, 1997; McCabe, 2003; Phipps, 1998; Roueche et al., 2001). Critics argue that postsecondary remediation wastes government money, lowers academic standards, and dismays faculty, while still satisfying an important role: providing opportunities for students.

Student Success Characteristics in Online Postsecondary Coursework

Cochran et al. (2014) discussed that the online modality for course offerings has been growing in its presence and use, and research has shown that like the attrition rates for traditional face-to-face courses, the asynchronous modality has similar attrition rates. Further research is needed to determine if the retention rates of online learning have any difference from the face-to-face modality. Current retention strategies that focus on the student demographics such as age, gender, race/ethnicity, and its relationship with academic factors of prior college performance (GPA), financial aid considerations, and

online course withdrawal history show correlations of these variables with success for online learners (Bailey & Morest, 2004; Rovai, 2003; Swan et al., 2009; Tinto, 1975, 1993; Whaley, 2015; Wladis et al. 2016; Zeidenberg, 2008). Cochran et al. identified a higher percentage of upperclassmen present in the sample, as juniors and seniors enrolled at a higher rate in the online courses being examined; research showed that the withdrawal rate for coursework steadily decreased as students progressed through their degree programs. The study examined retention of undergraduates in online coursework, comparing the results to previously researched face-to-face course retention rates by examining certain student characteristics and their relationships to an increase of withdrawals from online coursework. It found that the strongest factors in determining student online success were academic experience, a higher cumulative GPA, and a previous withdrawal from an online course, which were correlated to a lower rate of success (Cochran et al., 2014).

Wladis et al. (2016) discussed the relationship between student characteristics and the online environment and this relationship's ability to predict online performance and success, several key findings were identified. There is a significant correlation for predicting student achievement based on past student academic performance, particularly within the online modality. The potential to withdraw from online coursework is lowest among students in the upper levels of their coursework, particularly seniors. Freshmen are more likely to withdraw from an online course due in part to lower confidence to their academic ability (Wladis et al., 2016). In a comparison of academic performance or cumulative GPA to the withdrawal rates for this sample, it was discovered that students

that possessed a higher GPA in past coursework academically performed better in the online modality.

Aragon and Johnson (2008) found that "online completers were more likely to be female, enrolled in more classes, with a higher G.P.A." (pg. 151), but discovered no significant difference in academic readiness or self-directed learning. Black et al. (2015) identified that students entering postsecondary institutions are affected by their high school performance in that these high school characteristics show the predictive nature of the success of students in the first year of college. Additionally, this study identified that there is minimal evidence that the effect of these characteristics' declines pointing to the necessity for early intervention. This national study conducted by Wladis et al. (2016) informed the present study by identifying areas of statistical significance in the comparison of the relationship between student characteristics and the online environment and its ability to predict online performance and success. The ability for higher educational leaders to identify student characteristics that show increased chance for success online will allow institutions to create programs and systems to support students for greater online success.

Bork and Rucks-Ahidiana (2013) discussed the use of data about online courses at two community colleges within a framework of role and socialization theory to analyze how expectations of students and teachers differ. Research has suggested that there was a misalignment of student and teacher expectations, which led to ambiguity in the online context. The existence of role ambiguity tended to cause frustration, confusion, and tension among both the students and the instructors, as it was seen that both groups struggled to understand how their online roles related to similar face-to-face encounters.

As studies have shown, there exists mutual misalignment of expectations, coupled with a lack of exposure to the typical socialization processes that would be present in a face-to-face class, creating confusion and difficulty. Colleges need to investigate the need to implement institutional-level interventions, such as student readiness and faculty development activities, to bring the expectations more into line with each other. Jaggars (2014) explained: "The literature on faculty development suggests that top-down approaches to pedagogical improvement- such as one-time required faculty workshops- are unlikely to strongly impact instructors' everyday practices" (p. 36). Higher educational leaders must create and cultivate online professional development initiatives incorporating both the student perspective of faculty presence as well as the needs and desires of their online faculty.

The misalignment of the expectations regarding the roles of faculty and student within the online forum in areas such as motivation, social presence of faculty, and workloads were identified where improvements could benefit both students and faculty. Both students and teachers are unaware of the expectations of them in an online modality. In examining the perception of the student, they were unaware of the need to self-motivate and discipline themselves regarding learning. Faculty shared in a disconnect with the students in their expectation of the students' motivation as well as a knowledge deficit in the online teaching modality. Recommendations for better orientations for the students and professional development for the faculty would assist higher educational institutions. Identifying skill sets and the determination necessary for success in an online modality will assist community colleges in addressing deficiencies in the areas of self-efficacy and motivation online students need to succeed.

Student Satisfaction in Online Postsecondary Coursework

Bickerstaff et al. (2017) looked at confidence and related constructs such as self-efficacy that have been previously identified as important regarding college student persistence and performance. Existing research provides little indication of how confidence is shaped by a student's day-to-day interactions. Research has not fully explored the ability to identify the nature of experiences that positively reinforce student confidence, events that are termed experiences of earned success. Current research points to the fact that enrollment in college student success courses should be taken within the first 15 credits of coursework, especially for students enrolled in a community college system, and the authors of the study concurred. The responses revealed that students' descriptions of their confidence upon entering college shifted as they progressed. The study showed that the confidence that they possessed when they first entered the classroom spoke to the success that they encountered in that class as the semester progressed, and the shift in confidence they experienced as the semester concluded impacted their self-efficacy and motivation later in their coursework, particularly in their first few semesters. A student's confidence continually shifts because of interactions with peers, faculty, and others, the confidence that they feel factors into the motivation that they exude. The more confident they are in their abilities to succeed, the higher their sense of motivation in the class. Bandura (1993) explains "Students' beliefs in their efficacy to regulate their own learning and to master academic activities determine their aspirations, level of motivation, and academic accomplishments" (p. 117).

Research demonstrates how academic confidence can impact student motivation, commitment to academic pursuits, and behaviors associated to success. Bickerstaff et al.

(2017) analyzed the correlational nature self-efficacy and its impact on students' motivation has to student commitment to course completion and success.

Exactly why students elect to take courses online has been examined, and it has been identified that academic subject matter is one factor. Research has suggested that students who studied business, computer and information sciences, general studies, education, and healthcare enrolled in online classes at higher rates compared to students who studied social science, engineering, mathematics, and the humanities. In addition, students enrolled in associate degree programs were the most likely to enroll in online classes; students enrolled in certificate programs were the least likely to enroll (Radford, 2011; Swan, 2002). Student preference appears to be another factor in the selection of online coursework. According to Jaggars (2013), community college students elect to enroll in online versus face-to-face courses for three reasons: suitability, complexity, and format. Jaggars (2013) described that community college students found courses with laboratory components or coursework with substantial interpersonal interaction, such as public speaking or language, more appropriate for a face-to-face modality. Community college students also conveyed those difficult courses, such as those in the physical or life sciences, were beneficial to take face-to-face, while humanities courses were preferred online. Jaggars (2013) also reported that community college students preferred to take courses face-to-face if they have an interest in the subject matter, in contrast to liberal arts or general education courses that students are required to take for completion of degree requirements. The research of Jaggars (2013) showed that community college students choose online coursework to suit pre-existing academic experiences, needs, and preferences. It must be recognized that many times community college students do not

have an option. In the field of higher education, we see that some courses are offered only face-to-face or only online, which leads to students being obligated to opt into online courses or faced with the possibility of not taking them.

For it to be successful, online learning must be student centered and success driven. Online learning has grown quickly as the technology has developed (Swan, 2002), and in a time of shrinking state appropriations and declining enrollments community colleges today are expected to accomplish more, with less. Yet, one must consider if the present constraints facing community colleges are crucial to the extent that they are provide sufficient justification for placing more community college students in online coursework. It is an important time to consider this question: Should there exist a concern for and focus on student success as the primary factor in the decision to expand online learning, or should the success of the student be the primary focus above the needs of the institution?

Communities of Learning (CoL) in the Online Platform

Online learning has rapidly changed the traditional learning methodologies offered for years. It has transformed traditional face-to-face and synchronous exchanges, into online communities (Beins, 2016; Lawson, T.M., 2019; Manwaring et al., 2017; Swan, 2002). Distance education dates to the 18th century and has evolved into technologically focused modalities today (Kentnor, 2015; Kozan & Richardson, 2014; Lawson, T.M., 2019). Beginning with radio, into televisions, and eventually expanding to the worldwide web, society has improved technology to deliver information to those unable to be physically present. The increased use of online learning over the past decade has rapidly evolved and has been met with challenges such as geographic and schedule

difficulties, creating a separation of learners, and leaving them feeling isolated, frustrated, and unable to navigate online courses needed for success (Cleveland-Innes & Campbell, 2012; Lawson, T.M., 2019; Lee, 2014; Rodriguez et al., 2008; Swan, 2002; Swan et al., 2009). As students and teachers struggle to understand and adjust to online learning modalities used in distance education, required training and adjustment to the new delivery methods need to be implemented (Jacobi, 2017). To address this rapid advancement the scientific community has searched for and created innovative teaching practices to discuss online learning challenges (Garrison et al., 2001; Lawson, T.M., 2019; Swan et al., 2009). Communities of Inquiry (CoI) were developed as a conceptual framework aimed at implementing research-informed learning communities online that would eventually universalize online pedagogy. CoI achieved this by creating "presences" to help the learner develop a sense of self and community in online learning platforms (Garrison et al., 2001; Lawson, T.M., 2019; Swan et al., 2009).

Social interaction and integration are essential when students engage in an online course. While the appeal for community college students of online learning is significant as a learning modality because of its convenience, the distance between students and their institutions can be a clear obstacle to successful completion. Prior research has shown the importance of academic and social integration for student success (Lawson, T.M., 2019; Rovai, 2003; Tinto, 1975, 1993). Within the online environment, the task of fostering such integration is challenging, and yet such integration has been validated to be just as predictive of academic success as it is in face-to-face classes (Evans et al., 2016; Lawson, T.M., 2019; Liu et al., 2009; Swan et al., 2009). Shea et al. (2005) and Shea et al. (2006) demonstrated probable practices and theoretical models with which to do this. Today's

technological landscape allows for the creation of community and connection for students in online courses; it has never been easier. Still, it is important for both higher educational leaders and instructors to realize the importance of the creation of social connections in their online courses, connections that go beyond typical assessment and accreditation contact requirements. Online instructional faculty must emphasize interpersonal connection with their students and assist in the creation of communities within their courses, as exists in the traditional face-to-face contexts. Unfortunately, as researchers have just begun to identify pedagogies that will establish these presences (Shea et al., 2005; Swan et al., 2009), further training and awareness of the importance of social engagement by instructors is needed, for if the tools and processes with which to build it online are not communicated to all, online success for students will be affected (Johnson & Berge, 2012; Swan et al., 2009).

Summary

What should be clear is that online coursework as a share of overall coursework in the nation has grown considerably in the past decade and is forecasted to grow in the next. Course quality certainly matters, though prior research has found that course design and social presence were both critical factors in determining students' perceptions of and their success within online courses (Evans et al., 2016; Liu et al., 2007; Liu et al., 2009; Shea et al., 2006; Swan, 2002; Swan et al., 2009), student academic characteristics matter as well. Harrell and Bower (2011) found that community college students with higher GPAs, auditory learning styles, and advanced computer skills are more likely to continue in online courses. Berenson et al. (2008) discovered that community college students with

higher levels of emotional intelligence (EI) realized better results in online courses, yet the effect of this student characteristic has not been further explored.

Studies have demonstrated that various student characteristics including age, gender, academic preparation, and race, as well as course subject matter, predict online course enrollment, yet little research has been performed to identify ways to increase course completion and success for developmental mathematics students. While several large pioneering studies have reported no significant difference between online and face-to-face course outcomes, we still do not know with any certitude how online course-taking affects course completion for this distinctive sector of developmental community college students within higher education. Given the tremendous obstacles and expectations community colleges are expected to overcome, as these institutions have a mission to make good on the potentials for so many, online learning is a permanent and growing component of community colleges; more research is needed to investigate the success of students enrolled in developmental coursework in the online course environment.

CHAPTER 3

Methodology

As previously noted, more than half of all higher education institutions offer online classes, due to the ease of implementation, as well as the flexibility of scheduling for both the learner and the institution (Hoffman, 2006). With the exponential growth and popularity of online learning, institutions must continue to develop best practices in the areas of online teaching pedagogies and learning management platforms to promote student success, particularly among developmental learners. Community colleges are seeing growth in acceptance of online coursework (Jaggars & Bailey, 2010; Swan et al., 2009), as greater numbers of students are electing to take their required coursework in the online modality, leading institutions of higher education to offer more course sections within more disciplines. As such, online course developers continue to attempt to replicate the best practices of traditional classrooms. To determine what factors, impact online student success, a mixed methods explanatory sequential design will be employed to see if there are academic characteristics that exist to assist developmental mathematics learners in fully online college-level coursework. This chapter will provide details about the study population sample, research questions and design, data sources and collection procedures, and data analysis employed, as well as ethical considerations. The research questions that guided the current study were:

1. What is the predictive influence of demographic characteristics of age, gender, ethnicity, and socioeconomic status on successful course completion of developmental students enrolled in a college-level online mathematics course?

2. What is the predictive influence of academic characteristics of successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded on successful course completion of developmental students enrolled in a college-level online mathematics course?
3. How do students enrolled in a fully online mathematics course describe their participation and engagement within this course?

Quantitative Research Questions

1. What is the predictive influence of demographic characteristics of age, gender, ethnicity, and socioeconomic status on successful course completion of developmental students enrolled in a college-level online mathematics course?
    - Hypothesis H_0: Age, gender, ethnicity, and socioeconomic status have no predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.
    - Hypothesis H_1: Age, gender, ethnicity, and socioeconomic status have a predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.

To answer Quantitative Research Question 1, a binary logistic regression was conducted to determine which independent demographic student variables were predictors of successful online course completion in a college-level online mathematics course.

2. What is the predictive influence of academic characteristics of successful credit hours attempted, number of developmental courses taken, and number of credit

hours awarded on successful course completion of developmental students enrolled in a college-level online mathematics course?

- Hypothesis H_0: Successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded have no predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.
- Hypothesis H_1: Successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded have a predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.

To answer Research Question 2, a binary logistic regression was conducted to determine which independent academic student variables were predictors of successful online course completion in a college-level mathematics course. The criterion (dependent) variable was dichotomous, succeeded or did not. For the purposes of this study, success was defined as the students' ability to pass their respective college-level math course with a grade of C or higher.

Qualitative Research Question

3. How do students enrolled in a fully online mathematics course describe their participation and engagement within this course?

Research Question 3 employed a narrative approach to understand to what extent student perceptions and experiences of participation and collaboration were indicative of successful online course completion in a college-level mathematics course. I used a deductive coding process of a provisional list of codes developed from the quantitative

portion of the study. Using one-on-one semi-structured interviews, the researcher was able to analyze the data to determine the thematic story for those that were interviewed "told in their own words" (Creswell & Poth, 2018, p. 70), to determine themes and patterns for analysis.

Research Design

This study employed a mixed methods explanatory sequential design to investigate student characteristics contributing to academic success for developmental mathematic students online, taking into consideration identifiable student academic and demographic variables. A mixed methods explanatory sequential design was used to collect and analyze the data, to allow for a more robust and detailed representation of what the data can show us. Mixed methods research provides a structure for merging both quantitative and qualitative methods to allow for both models to collect, analyze, validate, and interpret the data (Briggs et al., 2012). Creswell & Gutterman (2019) identified that a mixed methods study can draw from both sets of data which can provide a more robust analysis then either research method alone. This two-stage, explanatory mixed method design allowed me to acquire statistical quantitative data from archival databases from the recognized institution and to follow up with select students to explore through semi-structured interviews those quantitative results with qualitative detail. Creswell and Plano Clark (2018) described explanatory sequential design as the best method to provide a more comprehensive and inclusive analysis of data, extracting information from both quantitative and qualitative methods. Creswell and Plano Clark (2018) explained that use of this research method provides for a more in-depth analysis by offering for comparative analysis and allowing for triangulation of the data. Mixed

methods studies afford an understanding that is both extensive and multifaceted, which is not possible to achieve using either a quantitative design or a qualitative design alone (Mills & Gay, 2019). Studies that utilize this methodology can be more thorough and comprehensive than research containing only one design (Creswell & Plano Clark, 2018).

Quantitative Data Collection Procedures

The quantitative data that were collected came from students enrolled at the identified institution during the academic semesters of fall 2017 to fall 2019. Creswell and Plano Clark (2018) explained a mixed methods explanatory sequential design "starts with the collection and analysis of quantitative data followed by the collection and analysis of qualitative data" (p. 65) to add depth and breadth to the results gathered. Collecting qualitative data, through semi-structured interviews from students can perhaps identify themes and patterns of elements of success for this cohort of students. The quantitative and subsequent qualitative information provided a fuller picture of what, if any, academic characteristics for student success can be identified for developmental mathematics community college online learners at a large tri-campus northeastern community college. The statistical data were attained by an IRB application from the institution to the Office of Planning and Institutional Effectiveness, using archival data culled from all three campuses of developmental mathematics learners that were enrolled in Statistics 1 (MAT 103), a first college-level mathematics courses, fully online from fall 2017 through the fall 2019. This college-level mathematics course is one choice that can be selected as a first programmatic, college-level credit-bearing class a developmental mathematic student may enroll in after completing the prerequisite developmental coursework. The data for the study included specific demographic and academic

characteristics for developmental mathematics students taking all online sections of MAT 103 mathematics courses offered during the fall 2017 through the fall 2019 academic terms, as they related to course completion rates for students enrolled at Pebbles Shores Community College. Successful course completion rates were defined as students that were awarded a letter grade of A, B, C, D, or F. Withdrawals and Incompletes were not used in the analysis, in that a withdrawal can be requested for many reasons not associated with persistence or success. Before beginning the statistical analysis for the hypothesis, the data were screened. As the dependent variable Final Grade is a dichotomous categorical variable measuring student success in an online mathematics course, listwise deletion was used to remove the two participants that were missing a final grade. Note these students had no grade because they were issued 100% Dean's Refund by the institution which voluntarily removed these grades, and not due to self-option withdrawal by the student. The cases that were removed from the data set were < 5% of the total data sample.

Variables of the Research Design

The independent variables comprised of demographic and academic characteristics that define this study:

Age: the age of the student while enrolled in the college-level mathematics course being studied. This predictor variable was included to investigate Research Question 1. Guided by the included framework, this variable was chosen as it shows the age of the student while enrolled in the course, potentially connecting to successful course completion (Bailey & Morest, 2004; Rovai, 2003; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008).

Developmental coursework: remedial noncredit-bearing courses offered as necessary to advance knowledge, required to remediate students' deficiencies in college entrance standards. These courses are not included in core coursework toward degree. This predictor variable was included to investigate Research Question 2. Guided by the included framework, this variable was chosen as it shows departure from the course may be guided by academic factors not associated to academic readiness (Chen, 2016; Wladis et al., 2016).

Ethnicity: was defined as non-White and White. This predictor variable was included to investigate Research Question 1. Guided by the included framework, this variable was chosen as it shows ethnicity of the student enrolled in the course may be an academic readiness barrier connecting to successful course completion (Bailey & Morest, 2004; Rovai, 2003; Swan, 2002; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008).

Gender: the self-identified term either male, female, or other. This predictor variable was included to investigate Research Question 1. Guided by the included framework, this variable was chosen as it shows the gender of the student while enrolled in the course, which potentially contributes to successful course completion (Bailey & Morest, 2004; Rovai, 2003; Swan, 2002; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008).

Socioeconomic status: this variable was determined by whether a student receives a Pell Grant toward tuition. This predictor variable was included to investigate Research Question 1. Guided by the included framework, this variable was chosen as it shows the socioeconomic status of the student while enrolled in

the course, possibly contributing to amount of time for coursework (Bailey & Morest, 2004; Rovai, 2003; Swan, 2002; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008).

Successful credit hours completed: the total completed credit hours, categorized by the number of credits successfully completed with a passing grade of C or better. This predictor variable was included to investigate Research Question 2. Guided by the included framework, this variable was chosen as it shows amount of time at the institution, essentially better connecting student to academic community (Braxton et al., 2011; Swan et al., 2009; Wladis et al., 2016).

The dependent variable was defined as:

Successful course completion: passing a course with a grade letter of all C or better.

The independent variables and the code rules that were used in the binomial logistic regressions for the quantitative phase are listed in Appendix G.

Participants

The sample for the study was all Pebbles Shores Community College developmental mathematics students enrolled in a specific college-level mathematics course offered fully online in at a large suburban, tri-campus, public community college located in the northeastern United States. The mixed methods explanatory sequential design compared course completion rates of developmental mathematics students enrolled in a specifically selected fully online college-level mathematics course: MAT 103.

Methods of Quantitative Data Collection and Analysis

In the first phase, quantitative hypotheses addressed the relationship of student academic and demographic variables of online students, previously having taken developmental coursework. The grade level awarded was looked at to determine online student success in comparison to different academic and demographics characteristics of developmental mathematic learners online. The data were kept on a secured, password-encoded hard drive in my possession.

I analyzed all students that enrolled in MAT 103 during the fall 2017 through the fall 2019, as this course is one of the choices that a developmental learner may take as the first college-level mathematics course. To determine the relationship of the demographic and academic factors and their predictive influence on online course completion, a binary logistic regression was used to determine the extent to which variables relate to online course completion. Meyers et al. (2017) explained that binary logistic regression analysis includes several independent variables and one dichotomous dependent variable used to calculate the relationship of demographic attributes and academic factors that may predict online course completion. Binary logistic regression is applied to explore which variables predict online course completion, when the dependent variable is dichotomous with two categories (Knapp, 2018). The study applied an alpha level of 0.5 in that I determined that the risks associated with committing a Type I error was quite reasonable and preferable to committing a Type II error by overlooking a true effect in the data. Meyers et al. concurred that the traditional alpha level of .05 sets the willingness to be wrong in rejecting the null hypothesis to 5% of the time. As the sample size of the participant will meet the *n quota* = 70, allowing for “larger sample sizes that result in more stable and

precise estimates of population parameters" (Meyers et al., 2017), the alpha level of .05 was chosen for this analysis. The assumptions of binary logistic regression will be tested for to see that the dependent variable of online course completion measured on a dichotomous scale (two groups: yes and no), the independent variables are continuous and categorical, the independence of the observations are met in that for the independent variables' participants only belong to one group or another. The conditions that the dependent variable contains mutually exclusive and exhaustive categories, there is linear relationship between the continuous independent variables and log odds, and that the minimum sample size (*n quota* = 70) will be met. As binary logistic regression analysis must assess the fit of the model to the data, each cell may not have an expectancy value greater than five for the assumption to be met. Finally, as binary logistic regression is very sensitive to high correlations among the predictor variable a collinearity analysis will be run to determine if the assumption will be met to see if there is no multicollinearity among the independent variables (Meyers et al., 2017).

Fraenkel et al. (2019) explained that "the basic causal-comparative design involves selecting two or more groups that differ on a particular variable of interest" (p. 368). I examined developmental mathematics students enrolled in the one specific identified gateway mathematics course, from fall 2017 through fall 2019, on the three campuses. The study exceeded the minimum sample size of 70 needed to be attained for analysis (Creswell, 2013 p. 146).

Table 3.1 identifies the descriptive statistics for each variable of age, gender, ethnicity, and socioeconomic status, total credits attempted, developmental math taken, and total credits awarded included in the successful online course completion model. Of

the study's full sample (N = 217), the cases were split by age: 63.1% non-traditional and 36.9% traditional. By ethnicity, 47.0% identified as non-White and 53% identified as White. When examining gender, the statistics identified 32.3% male and 67.7% female. Finally, the socioeconomic status of the sample found 62.2% did not receive Pell grants, while 37.8% did receive Pell grants.

Table 3.1

Successful Online Mathematics Course Completion Model Descriptive Statistics

Variable	Count *(N = 217)*	Percentage
Background Characteristics		
Age		
Non-Traditional	80	63.1%
Traditional	137	36.9%
Ethnicity		100%
Non-White	102	47.0%
White	115	53.0%
Gender		
Male	70	32.3%
Female	147	67.7%
Socioeconomic Status		100%
Not awarded	135	62.2%
Awarded	82	37.8%
Academic Characteristics		
Total Credits Attempted		63.42%
Developmental Math		
One course	176	79.7%
More than one	41	20.3%
Total Credits Awarded		55.34%

Note: Weighted sample. Means may not equal 100% due to rounding.

To determine if there was a difference in course completion outcomes based on age, gender, ethnicity, and socioeconomic status, a binary logistic regression was employed. In the model, course completion was the dependent variable, and age, gender, ethnicity, and socioeconomic status were the independent variables. The dependent

variable was encoded for course completion as non-successful or successful. An alpha level of 0.5 was chosen for the logistic regression analysis. All statistical analyses were conducted using the SPSS v 24 software.

A logistic regression analysis was performed to evaluate the fit of the model to the data. The dependent variable of successful online mathematics course completion is measured on a dichotomous scale (two groups: yes and no) meeting the first assumption. There are seven independent variables: two that are continuous and five that are categorical (see Table 3.2). There was independence of the observations in that for the independent variables, participants could only belong to one group or another, and the dependent variable contained mutually exclusive and exhaustive categories. There was a linear relationship between the continuous independent variables and log odds. The minimum sample size (*n quota* = 70) was met. A logistic regression analysis was performed to assess the fit of the model to the data. Each cell does have an expectancy value greater than five, so the assumption is met. As binary logistic regression is very sensitive to high correlations among the predictor variable, I ran a collinearity analysis to determine if the assumption was met to see if there is no multicollinearity among the independent variables (Meyers et al., 2017). A preliminary multiple regression analysis showed that collinearity among predictor variables was not a problem with the current sample because all the *VIF* scores were well below 10, and the tolerance scores for all were above .20. The results show there is no multicollinearity among the independent variables. As the correlation is not significant, the required assumptions tests were met for the logistic regression analysis.

Table 3.2

Binary Logistic Regression Results for the Independent Variables

Independent Variable	*b*	*SE*	*Wald*	*df*	*Sig.*	*Exp(B)*	95% C.I. for *Exp(B)* Low	Upper
Model								
Participant Gender	-.104	.339	.094	1	.760	.901	.463	1.753
Socioeconomic Status	-.239	.326	.537	1	.464	.788	.416	1.492
Non-Traditional	1.085	.344	9.963	1	.002	2.960	1.509	5.805
Ethnicity	.729	.306	5.688	1	.017	2.074	1.139	3.776
Attempted Credits	-.041	.013	10.538	1	.001	.960	.936	.984
Number of Developmental Math Classes Taken	-.247	.366	.457	1	.499	.781	.381	1.599
Number of Credits Awarded	.069	.015	20.487	1	.000	1.071	1.040	1.103
Constant	-1.544	.691	4.991	1	.025	.214		

Note: N = 217; * $p < .05$

a. Dependent Variable: Successful Course Completion

The present study was designed to examine the impact of age, gender, ethnicity, socioeconomic status, total credits attempted, developmental courses taken, and total credits awarded on successful course completion of N = 217 developmental students enrolled in the first credit-bearing mathematics course online.

Reliability and Validity of the Research Design

The mixed methods explanatory sequential design is vulnerable to both internal and external threats because it lacks both random assignment and precise treatment manipulation. As with all mixed methods designs, the researcher needed to establish the validity of the quantitative data scores, Creswell and Plano Clark (2018) further explained the accuracy of the findings may be compromised due to the researcher not

considering all possible findings. To minimize the possible threats to reliability, the researcher used archival data that eliminated contact with the subjects.

Methods of Qualitative Data Collection and Analysis

Creswell and Plano Clark (2018) explained that the intent of mixed methods explanatory sequential design is to develop a qualitative strand to explain initial results developed from quantitative data. Students were selected to participate in a 1-hour follow-up interview with me. Participants were randomly selected from the quantitative data findings of students having taken MAT 103 between fall 2017 and fall 2019, the first phase of the study. The interview questions for the qualitative second phase were developed after analysis of the results gathered in the quantitative portion of the study, based on the research into the variables. I employed semi-structured interviews to collect a rich and robust data sample, grounded in the quantitative results (see Appendixes B and C). The purpose of conducting semi-structured interviews is to further explore the initial findings of the quantitative data analysis to provide the researcher with a more robust and detailed description as to the use and role of online learning and student success. Saldaña (2016) explained that In Vivo coding is a common name given to the form of coding that places emphasis on the actual spoken words of the participants, which can be beneficial when examining members of a specific group. The method of In Vivo coding relies on adapting to the participants' perspectives and actions, thus providing the qualitative data to be also labeled as "literal coding" (p. 105).

Demographic Information About the Student-Participant Interviewees

The student-participants for the qualitative portion of the study were identified from the study institution Pebbles Shores Community College through emails provided

by the Office of Planning and Institutional Effectiveness, granted through the IRB. These student-participants volunteered to contribute and offer their distinctive experiences and views of taking their first gateway mathematics course within an online modality platform. The student-participants for the qualitative phase were identified from the quantitative phase results and their demographic information is listed in Table 3.3.

Table 3.3

Description of Interview Participants

Student Pseudonym	Gender	Age	Developmental Coursework
Emily	Female	25 and older	Two courses
Gina	Female	18–24	One course
Christina	Female	18–24	No courses
Ruprecht	Male	25 and older	No courses
Shaun	Female	25 and older	One course

The participants were interviewed in a semi-formal, one-on-one manner virtually, using Zoom and recording the audio. I transcribed the Zoom audio recordings using a cloud-based software known as Otter.ai, allowing for the transcription to be created into a document that was uploaded to Dedoose for the identification and analysis of themes and patterns. In the first cycle coding, the In Vivo method was used to identify quotes and phrases to provide validation to the data results yielded from the quantitative portion of the research. After analyzing the data, re-coding or second cycle coding took place to look for themes within the quotes, phrases, and words. The second cycle coding process used process coding which Saldaña (2016) explained is “action coding” (p. 111), allowing for the identification of broader concepts and themes to be identified. I

continued re-reading, re-coding, and revising the data to enable the themes to emerge. The themes were coded based on the research questions but were not limited to them.

Instruments

I administered a semi-structured interview protocol (see Appendixes B and C), to gather the qualitative data to identify emerging themes and patterns, grounded in the results of the quantitative portion. This semi-structured protocol was used to interview students previously enrolled in developmental mathematics coursework to capture descriptions of their experience with enrolling in and completing a college-level online mathematics course. It allowed the students to reply openly and honestly, allowing me to attain their perspective. The semi-structured interviews consisted of 11 questions based on the student's experience in an online college-level mathematics course at Pebbles Shores Community College, with the last question allowing the students to include any thoughts or ideas they feel could provide a deeper understanding. Each question aligns with the literature and asks the student's perception of their characteristics, satisfaction, online learning use, developmental math learner, Communities of Learning, and their effect on the student's decision to persist in an online course. This protocol directly related the research questions to the research as well as the perspective of each student. Table 3.4 is a visual depiction of the relationship of the research questions to the literature and theory base.

Table 3.4

Relationship of the Research Questions to the Literature-Based Student Interview Protocol

Student Interview Protocol Question	Research Question	Subtopic	Author
1. Can you tell me a little bit about yourself and your education to date?	R1	Student Characteristics	Aragon & Johnson, 2008; Black et al., 2012; Bork & Rucks-Ahidiana, 2013; Cochran et al., 2014; Jaggars, 2014; Wladis et al., 2016
a. What brought you to this institution?	R1a	Student Characteristics	Aragon & Johnson, 2008; Black et al., 2012; Bork & Rucks-Ahidiana, 2013; Cochran et al., 2014; Jaggars, 2014; Wladis et al., 2016
b. What are your educational goals?	R1b	Student Characteristics	Aragon & Johnson, 2008; Black et al., 2012; Bork & Rucks-Ahidiana, 2013; Cochran et al., 2014; Jaggars, 2014; Wladis et al., 2016
c. What are your career goals?	R1c	Student Characteristics	Aragon & Johnson, 2008; Black et al., 2012; Bork & Rucks-Ahidiana, 2013; Cochran et al., 2014; Jaggars, 2014; Wladis et al., 2016
2. Tell me about the courses you have taken and are taking this semester.	R1	Student Satisfaction	Bandura, 1993; Bickerstaff et al., 2017; Jaggars, 2013; Radford, 2011
a. What other courses have you taken online?	R1a	Student Satisfaction	Bandura, 1993; Bickerstaff et al., 2017; Jaggars, 2013; Radford, 2011
b. Did you take these online classes before your first college-level mathematics course online?	R1b	Student Satisfaction	Bandura, 1993; Bickerstaff et al., 2017; Jaggars, 2013; Radford, 2011
3. Why did you take *MAT 103* online instead of face-to-face?	R3	Online Learning Use	Atchley et al., 2013; Bambara et al., 2009; Beatty-Guenter, 2003; Hachey et al., 2014, 2015; Hyllegard et al., 2008; Jaggars, 2011; Kaupp, 2012; Klein et al., 2015
a. Did you talk to anyone who had taken the course online before you registered to enroll?	R3a	Online Learning Use	Atchley et al., 2013; Bambara et al., 2009; Beatty-Guenter, 2003; Hachey et al., 2014, 2015; Hyllegard et al., 2008; Jaggars, 2011; Kaupp, 2012; Klein et al., 2015
b. Were you advised by an advisor or faculty prior to registration?	R3b	Online Learning Use	Atchley et al., 2013; Bambara et al., 2009; Beatty-Guenter, 2003; Hachey et al., 2014, 2015; Hyllegard et al., 2008; Jaggars, 2011; Kaupp, 2012; Klein et al., 2015
c. Did you take it online due to your personal schedule/or lack of course time offering to match your availability?	R3c	Student Characteristics	Aragon & Johnson, 2008; Black et al., 2012; Bork & Rucks-Ahidiana, 2013; Cochran et al., 2014; Jaggars, 2014; Wladis et al., 2016

Student Interview Protocol Question	Research Question	Subtopic	Author
4. Tell me about the work expected for this course.	R4	Developmental Learner	Arendale, 2010; Bailey & Morest, 2004; Brier, 1984; Boylan, 2002; Boylan et al., 2005; Casazza, 1999; Goodchild & Weschler, 1997; Lake, 2001; McClenney, 2004; Zeidenberg, 2008
a. What did you like about the content and why?	R4a	Developmental Learner	Arendale, 2010; Bailey & Morest, 2004; Brier, 1984; Boylan, 2002; Boylan et al., 2005; Casazza, 1999; Goodchild & Weschler, 1997; Lake, 2001; McClenney, 2004; Zeidenberg, 2008
b. What assigned tasks were easy to understand and accomplish? What assigned tasks were challenging to you?	R4b	Developmental Math	Adelman, 2004; Asera, 2011; Bahr, 2010, 2012a, 2012b; Bissell, 2012; Bonham & Boylan, 2012; Bremer et al., 2013; Daugherty et al., 2013; Gerlaugh et al., 2007; Waycaster, 2011
c. Was there any part of the online course you could not handle?	R4c	Developmental Math	Adelman, 2004; Asera, 2011; Bahr, 2010, 2012a, 2012b; Bissell, 2012; Bonham & Boylan, 2012; Bremer et al., 2013; Daugherty et al., 2013; Gerlaugh et al., 2007; Waycaster, 2011
5. How well did you plan your time to study and work online each week? a. Were you successful? How did your study/work plan turn out?	R5	Student Satisfaction	Bandura, 1993; Bickerstaff et al., 2017; Jaggars, 2013; Radford, 2011
6. Did you form any relationships with other students in the course? And how was that accomplished in the course?	R6	Communities of Learning	Berenson et al., 2008; Campbell, 2012; Cleveland-Innes & Evans et al., 2016; Garrison et al., 2001; Harrell & Bower, 2011; Jacobi, 2017; Lee, 2014; Liu et al., 2009; Liu et al., 2007; Rodriguez et al., 2008; Rovai, 2003; Shea et al., 2005; Shea et al., 2006; Tinto, 1975, 1993
a. If yes, did these social connections help you toward success?	R6a	Communities of Learning	Berenson et al., 2008; Cleveland-Innes & Campbell, 2012; Evans et al., 2016; Garrison et al., 2001; Harrell & Bower, 2011; Jacobi, 2017; Lee, 2014; Liu et al., 2009; Liu et al., 2007; Rodriguez et al., 2008; Rovai, 2003; Shea et al., 2005; Shea et al., 2006; Tinto, 1975, 1993
b. If not, did the lack of social connections hold you back in completion?	R6b	Communities of Learning	Berenson et al., 2008; Cleveland-Innes & Campbell, 2012; Evans et al., 2016; Garrison et al., 2001; Harrell &Bower, 2011; Jacobi, 2017; Lee, 2014; Liu et al., 2009; Liu et al., 2007; Rodriguez et al., 2008; Rovai, 2003; Shea et al., 2005; Shea et al., 2006; Tinto, 1975, 1993

Student Interview Protocol Question	Research Question	Subtopic	Author
7. Would you take an online mathematics course in the future?	R7	Student Satisfaction	Bandura, 1993; Bickerstaff et al., 2017; Jaggars, 2013; Radford, 2011
8. Do you believe you were successful in this online college-level mathematics course?	R8	Student Satisfaction	Bickerstaff et al., 2017; Bandura, 1993; Jaggars, 2013; Radford, 2011
9. What was your perceived success in this online college-level mathematics course? And would you be comfortable to share the grade you received?	R9	Student Satisfaction	Bickerstaff et al., 2017; Bandura, 1993; Jaggars, 2013; Radford, 2011
10. In your opinion what would have improved this online college-level mathematics course? Any advice for other students?	R10	Student Characteristics	Aragon & Johnson, 2008; Black et al., 2012; Bork & Rucks-Ahidiana, 2013; Cochran et al., 2014; Jaggars, 2014; Wladis et al., 2016
11. What questions do you have for me about this study?	R11		

In the second phase, qualitative semi-structured interviews were conducted to explore aspects of student success as experienced by individuals identified in the first phase. The concept for the study was based on previous studies and was tested by examining existing community college developmental mathematics students within their first college-level mathematics course online.

Research Procedures and Ethics

After receiving approval from the University's Institutional Review Board, letters of consent, along with copies of the research proposal were sent to the Office of Institutional Effectiveness. Researchers must obtain permission from the individuals in positions of authority to gain access to research sites and the study participants within these sites (Creswell, 2013). Once approval to conduct the study was granted invitations were sent to participants selected from the quantitative results of the study. The invitation explained that participation in the study is voluntary and that the participants could decline to participate at any time. Participation in a study must be understood to be

voluntary, participants must understand that the agreement to participate can be withdrawn at any time, and the participants must have a clear understanding of the purpose of the research study (Creswell, 2013). Once the participants were identified and accepted, a unique identification code was assigned to each to protect and maintain confidentiality during the analysis of the qualitative data (Creswell, 2013). I conducted the interviews and confidentiality was maintained by the assigning of pseudonyms for all participants. The semi-structured interviews were audio recorded utilizing the audio recording feature of Zoom and analyzed to identify emerging themes and patterns. To assure the credibility of the study, the dissertation was shared with all participants, institutional leadership, and other researchers (Creswell, 2013).

Trustworthiness of the Design

To ensure the research findings and interpretations are accurate and credible, the researcher must substantiate the findings through strategies such as triangulation or assessing (Creswell, 2013). Using triangulation, multiple sources of data are used to authenticate assertions, to ensure reliability (Creswell, 2009; Stake, 1995). The triangulation of the information gathered assisted me to develop a coherent justification for themes and patterns noted (Creswell, 2013). Quantitative research employs the terms *validity* and *reliability* to describe the accuracy, while in qualitative research, researchers often use the term *trustworthiness* to reference the concept of validity (Creswell, 2013). To assure the trustworthiness within the qualitative portion of the study, I kept field notes and memos during the semi-structured interviews. Hays and Singh (2011) identified that field notes and memos are additional sources to describe and analyze the data associated with interviews, documents, and observations collected during the qualitative stage.

Additionally, I implemented thick description to strengthen the results of the findings (Hays, & Singh, 2011).

Creswell and Poth (2018) identified four primary criteria for evaluating trustworthiness: credibility, are the results accurate; authenticity, are the participants voices heard; criticality; and researcher integrity. Using triangulation, I assured that any emphasis that seems hidden will be addressed. An interview protocol was followed to ensure the trustworthiness and credibility of the research study, thereby assuring that the same interview questions were asked of all participants. This allowed me to take notes during the interview and stay on point. The interview protocol helped me organize my thoughts on topics of the questions how to begin the interview, concluding ideas, information on ending the interview, and how to thank the respondent (Creswell, 2013).

Limitations and Delimitations

This mixed methods explanatory sequential design-based study aims to understand to what extent do student demographic and academic characteristics contribute to academic success for developmental mathematic students online. The study was limited to one 2-year multi-campus community college in the Northeast and as such, the results may not be transferable to other regions or differing institutional types. The sample size in the qualitative portion was limited, and therefore the research findings may only be representative of a distinctive set of perceptions or outcomes. As this study was conducted with a convenience sample, it therefore will only be able to be generalized to the community college students directly related to this study and cannot be stated with confidence to be representative of the population (Creswell, 2013). The demographic data

for this study are from self-reporting information gathered through the admission application and stored in the student record system.

Role of the Researcher

The role of the researcher is to act as the primary data collection instrument and as such it is necessary to identify the personal values, assumptions, and any biases present at the beginning of the study (Creswell & Gutterman, 2019). Creswell and Gutterman (2019) discussed that using qualitative methods will produce a wealth of comprehensive information applicable to a small number of participants and cases and will increase the wealth of knowledge and understanding of a situation. I employed multiple strategies to identify and validate the accuracy of the information gained. Although every effort was taken to ensure objectivity, I am aware that my feelings and beliefs may impact the way in which I designed the study and how I interpret the data. I am also aware that my experiences as an instructor in the online modalities may alter my view of the benefits of the style or instruction. To diminish these impacts, I have factored in time for reflection on my values and beliefs and how they may impact the study. I also regularly shared my research study and design with my faculty mentor to receive feedback.

Conclusion

The purpose of this chapter was to illustrate the research methodology of the study, the data sources and the sample, the data collection and analysis methods, and to explain any issues with trustworthiness and limitations. This study applied a mixed methods explanatory sequential design to address the research questions and was imbedded as a single case. The sample size for the qualitative section of the study was limited and therefore the research findings may only be applicable to a limited setting.

CHAPTER 4

The purpose of this mixed methods explanatory sequential study was to determine whether there were statistically significant relationships between (a) student age, (b) student gender, (c) student ethnicity, (d) student socioeconomic status, (e) student credit hours attempted, (f) number of developmental courses taken, and (g) number of credit hours awarded of community college developmental mathematics learners and their perceptions of and engagement within their first online gateway mathematics course. As Creswell and Plano Clark (2018) explained, using mixed methods research allows the whole story to emerge by filling in the existing knowledge gaps that might develop from using only one method. The focus was to understand the respective, lived experiences and perspectives derived through engagement and collaboration within an online mathematics course, that yielded successful course completion. The study explored the relationships quantitatively between age, gender, ethnicity, socioeconomic status, student credit hours attempted, number of developmental courses, and number of credit hours awarded taken, and then established an interview protocol allowing for further elaboration. Results were derived for each research question. This chapter presents the data analysis findings for the two research questions resulting from the IRB approved statistical data. Results were then used to develop the quantitative protocols yielding the qualitative results from the semi-structured interviews of the student-participants.

Data and Sample

To determine the relationship of the demographic attributes and academic factors and their correlation to successful online mathematics course completion, a binary logistic regression was performed. Logistic regression was used to explore which

variables were significant predictors of online mathematics course completion. The dependent variable, successful course completion, is a dichotomous outcome variable with two categories: yes or no (Knapp, 2018). I chose the test as logistic regression predicts the possibility that an observation falls into one of two categories of a dichotomous (two-level) categorical dependent variable based on one or more independent variables that can be either continuous or categorical. Logistic regression assesses the relationship among the variables to provide a model that describes the factors associated with the observed outcome. The first phase of the study was quantitative; the logistic regression analysis I performed compared several independent variables and one dependent dichotomous variable for the prediction of the relationship of demographic attributes and academic factors to successful online mathematics course completion. The independent variables age, ethnicity, gender, socioeconomic status, and developmental mathematics were categorical, meaning that they contained values of membership in one or the other category and were dummy coded for the regression analysis. The present study was designed to examine the effects of age, ethnicity, gender, socioeconomic status, online classes taken, successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded for a sample of (N = 217) community college students. For the qualitative phase of the study a narrative approach was used. Creswell and Poth (2018) described that narrative research, in its many forms, employs a variety of analytical methods, rooted in different social and humanities disciplines. This method begins with the lived experiences as expressed and conveyed through stories of individuals. Upon email recruitment, five student-participants volunteered to be included in the interview sessions. These five students were all currently enrolled at Pebbles

Shores Community College and had enrolled in an online college-level mathematics course.

Quantitative Findings

Research Question 1

What is the predictive influence of demographic characteristics of age, gender, ethnicity, and socioeconomic status on successful course completion of developmental students enrolled in a college-level online mathematics course?

- Hypothesis H_0: Age, gender, ethnicity, and socioeconomic status have no predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.
- Hypothesis H_1: Age, gender, ethnicity, and socioeconomic status have a predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.

Results for Binary Logistic Regression. A standard binary logistic regression was performed to ascertain the effects of age, ethnicity, gender, and socioeconomic status for predicting successful online mathematics course completion. Based on a classification threshold predicted probability of target group membership as .5, the results indicate that the full model was statistically significant (χ^2 = 38.447, *df=7, N=217*, p = .000). Table 4.1 shows the proportion variance in successful course completion accounted for by the model was small (Nagelkerke R^2 =.217), accounting for only 21.7% of the online mathematics course completion and correctly classified 55.8% of the cases. Increasing age of the online learners was associated with a 2.960 increased likelihood of course

completion (95% CI 1.509 – 5.805), and students with classification as White were 2.074 times more likely to complete an online course (95% CI 1.139- 3.776).

Table 4.1

Binary Logistic Regression Results of the Factors Predicting Online Course Completion

Model	*B*	*S.E.*	*Odds ratio*	*p*
Gender	-.104	.339	.901	.760
Socioeconomic Status	-.239	.326	.788	.464
NonTraditional	1.085	.344	2.960	0.002**
Ethnicity	.729	.306	2.074	0.017*

Notes: In the table, Odds Ratio *(OR)* is *Exp (B).*
Effect Size Guidelines for ORs: 1.68(.60) = small, 3.47(.29) = medium, 6.71(.15) = large (Chen et al., 2010).
The dependent variable was online mathematics course completion with successful (yes) as the reference category or not successful (no) as the target category. Developmental students were the focus group of the status category; Nagelkerke R^2 = .217.
*$p<.05$, **$p<.01$

Summary of Findings. Logistic regression was conducted to assess whether the four predictor variables, age, gender, ethnicity, and socioeconomic status, significantly predicted whether a student successfully completed their first college-level mathematics course online, given their status of requiring developmental mathematics coursework upon college entry. When all four predictor variables are considered concurrently, they significantly predict whether a student successfully completed their first college-level mathematics course online. This analysis indicates that the null hypothesis is rejected, as age and ethnicity significantly influenced whether online developmental learners completed a course.

Research Question 2

What is the predictive influence of academic characteristics of successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded on successful course completion of developmental students enrolled in a college-level online mathematics course?

- Hypothesis H_0: Successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded have no predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.
- Hypothesis H_1: Successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded have a predictive influence on successful course completion of developmental students enrolled in a college-level online mathematics course.

Results for Binary Logistic Regression. For this question a binary logistic regression was performed to ascertain the effects that successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded revealed for predicting successful online mathematics course completion. Based on a classification threshold predicted probability of target group membership as .5, the results indicate that the full model was statistically significant ($\chi^2 = 38.447$, *df=7, N=217*, $p = .000$). Table 4.2 illustrates the proportion variance in successful course completion accounted for by the model was small (Nagelkerke $R^2 = .217$), accounting for only 21.7% of the online mathematics course completion and correctly classified 55.8% of the cases. Results showed attempted credits showed a .960 increase in the successful completion of online

learners (95% CI .936 – .984). While the number of awarded credits for students showed a 1.071 increased likelihood of successful online mathematics completion (95% CI 1.040 – 1.103). These statistically significant results showed that the number of attempted credits taken as well as the number of credits awarded were significant predictors in predicting whether a student successfully completed their first college-level mathematics course online.

Table 4.2

Logistic Regression Results of Number of Credits Awarded in Predicting Online Course Completion

Model	*B*	*S.E.*	*Odds ratio*	*p*
Attempted Credits	-.041	.013	.960	.001*
Number of Development Math Taken	-.247	.366	.781	.499
Number of Credits Awarded	.069	.015	1.071	0.000**

Notes: In the table, Odds Ratio *(OR)* is *Exp (B)*.
Effect Size Guidelines for ORs: 1.68(.60) = small, 3.47(.29) = medium, 6.71(.15) = large (Chen et al., 2010).
The dependent variable was online mathematics course completion with successful (yes) as the reference category or not successful (no) as the target category. Developmental students were the focus group of the status category; Nagelkerke R^2 = .217.
*$p<.05$, **$p<.01$

Summary of Findings. Logistic regression was conducted to assess whether the three predictor variables of successful credit hours attempted, number of developmental courses taken, and number of credit hours awarded significantly predicted whether a student successfully completed their first college-level mathematics course online, given their status of requiring developmental mathematics coursework. When all three predictor variables are considered concurrently, they significantly predict whether a student successfully completed their first college-level mathematics course online. This analysis indicates that the null hypothesis is rejected, as successful credit hours attempted, and the

number of credit hours awarded significantly influenced whether online developmental learners completed a course.

Qualitative Research Question

Research Question 3

How do students enrolled in a fully online mathematics course describe their participation and engagement within this course?

Due to the COVID-19 pandemic, and for the safety of all involved in the study, in accordance with state mandates and institutional guidelines to social distance, all qualitative data were collected electronically via Zoom, and transcribed using the web-based Otter.ai. The purpose of the interview protocol was to gain rich and copious responses representing the perspectives and lived experiences of the student-participants interviewed (remotely, via Zoom). Each student-participant was interviewed individually with the request that the student-participants, when possible, and if comfortable, could elaborate with as much detail as possible in their responses to the semi-structured questions.

Each interview was video/audio recorded with consent using Zoom, and then later transcribed using Otter.ai, an online transcription service. Then, I reviewed the transcription to check completeness and correct interpretation. The first cycle of the analysis involved charting descriptive words and phrases for each participant for each question.

Collaboration: Active Presence, Development of Social Connections, and Peer Communication. *Collaboration* emerged from the interviews as a theme, as each interviewee elaborated on their philosophies and viewpoints to the form of collaboration

that existed within their online mathematics class. Within that collaboration each interviewee classified a self-defined interpretation of presence with the online mathematics course taken and how the presence was actuated. Each student-participant explained that the form of presence created influenced their viewpoint of collaboration. Yet, this collaboration was not specifically identified as forming from any one source of presence, as each of the students identified their own awareness. Emily shared her understanding of collaboration:

> If you don't have somebody to bounce your ideas off, or to help you with your understanding of the equation, you can have a difficult time. I find having someone to be able to bounce ideas off helps me, maybe with seeing the same equation just in a different way.

Emily's response shows how participation and idea generation enhances one's own knowledge. She shared that when she assisted other students within the online mathematics course, her comprehension increased also. Shaun revealed that for her, the presence was created in her being a mentor to others within her course. As a non-traditional student with children, Shaun naturally gravitated toward being a maternal figure regarding assisting other students in her class. Her ability to ask questions of the professor for her own comprehension, likened her to being a natural leader for her classmates. Research about non-traditional students shows they thrive on intense, collaborative discussions (Ellis, 2019; Ziegler et al., 2014). As the online collaboration theory identifies the final stage, intellectual convergence is where the learners create a shared interpretation by incorporating their ideas and knowledge thus forming distinct points of view and positions, which creates convergent thinking.

Like Emily and Shaun, Gina recognized the benefit of engagement with the students and faculty member when it comes to comprehension and learning mathematics. “I believe visually seeing the professor write on the chalkboard or a whiteboard, or on a computer doing the equation helps me comprehend.” She explained that having the ability to discuss or engage with her instructor allowed her to see the equation worked out in different ways; this created an instructor presence for her. This expanded her knowledge by providing for learning through problem solving using different methods. Similarly, Christina pointed out that she found success by promoting engagement, “I think I tried to reach out to the professor and honestly tried to form relationships with other students so that I could get that help.” Christina believed that this collaborating and engagement was beneficial and assisted her in doing well in her online mathematics class.

Ruprecht noted that for him, engagement with the professor was most important for student success. He explained that the development of social presence in an online modality was the responsibility of both the student members of the class and the professor. Ruprecht explained, “you must communicate with the professor, even if it’s an online class, let them be the ones that are uncommunicative.” As Ruprecht explained, the ability to connect and discuss the lesson expands the proficiency to understand and continues the learning within the course. And the aspect of social connections assisted students to share their thoughts and comprehension of the problem, increasing their learning. Emily explained that the connections she made in the college and the connections that she made with other students and faculty, in the course, helped her with connecting to the learning. By enjoying the atmosphere and her peers, the learning was

amplified. Gina explained how she felt that social connections to other students will foster success and collaboration in the online platform:

> My advice for success in online learning would be to find at least one person in the class you connect with. I like to seek out ways to contact other students, at least one in every class, to be able to email or group chat. That way you have other methods of talking to others, who might have the answers to your question.

This social connection for Gina assisted her in collaborating. For Gina to have a reliable person to ask questions about the course and areas that she is unsure about was helpful; Gina also found this type of social communication with her professor.

The interviewees all agreed that communication was important for collaboration to take place. Emily instructed that for success in the online modality: “Don’t be afraid to email other students. Don’t be afraid to email professors, or anybody really who knows what you’re asking about.” Emily expressed that both students and faculty learn to connect in an online format, noting that this engagement or connection as any other learning modality assists with the knowledge and augments the lessons. The connections create a community of learners in an online course and assists both the students and the teachers. Emily explained for her the communication between the students in her online course came from a connection created in an online texting site called GroupMe. She explained that this text-based chat site allowed for her and her classmates to discuss and yield information from each other in an electronic format outside of the course. Created by those students in the online mathematics class that she was registered it allowed for formal and informal communication. The advantage Emily found in GroupMe was that it

existed outside the learning management system and was accessible 24 hours a day, thus giving a support system for students.

Dissimilarly to Emily, Gina experienced a sense of disconnect and believed that there was a loss of presence of social connections both in teacher to student as well as student to student. Gina's sense of disconnect was not limited to the social connections; her experiences online extended to the virtual collaboration. She experienced difficulties in the connection aspect as many of her classmates did not share their screens and had their microphones muted, creating a void for Gina in connecting to her faculty and her classmates.

Shaun shared that for her student collaboration came in the form of groupwork. She communicated:

> I feel by putting people in groups, maybe assigning people to groups . . . we would have the opportunity to work together. So, say David, Liza and I were put in a group. . . So, we're the group throughout the semester, I can rely on you, you can rely on me, I can ask you for assistance, and you can ask me. That group of people can be assigned to you throughout whole semester and give you someone to communicate and work together with.

Shaun further went on to explain her positive feelings toward groupwork within the online platform, explain that using group projects she and her classmates were able to connect outside of the course and this connection allowed for further learning to occur.

This concept of group formation finds its connections to the research of Garrison (2000), who identified the communities of learning and its importance to the foundation of collaboration. As present-day communities of learners are engaging in groupwork and

sharing in the formation of ideas, educational professionals are embracing concepts which enhance the learning for online work. One of the ways through which this is accomplished is in the use of discussion boards within the learning management system. Shaun saw the benefit to online learning, elaborating:

> I think the discussion board is good, but it's just in how the teacher words it, teachers must grade students on what they're learning . . . if it was more familiar, then people can engage in the discussion, and it would allow students to engage in the materials and facts.

Whiteside (2015) identified the faculty importance in social presence "as a master conductor that synchronizes the instructor, students, norms, academic content, learning management system (LMS), media, tools, instructional strategies, and outcomes within a learning experience" (p. 11). When comparing online learning to traditional face-to-face coursework for the presence of engagement of both the student and the instructor, the research points to formation of engagement being created through components of the learning management system. Research has validated that social presence not only affects results but also student, and possibly instructor, fulfillment with a course (Swan, K., 2002).

All the student-participants found that the theme of collaboration existed, but as in traditional coursework it occurred in different forms for each student and course. What each student-participant did share was that for them the subtheme of presence of both their professors and their classmates was integral in the creation of collaboration. Collaboration within the online learning theory creates a connection and presence for the members of the course to discuss and elaborate on the lessons within, creating the

concept of *idea generation*, which is one of the aspects of the theory. As all the participants imparted, there needed to exist a way for the class and their teacher to not only communicate but to share thoughts and ideas for the learning to be enhanced.

Connection: Technology Knowledge, Development of Time Management Skills, and Obstacles. Connection incorporates the learning management platform examined through technology knowledge, time management skills, and obstacles for the students, as these affect the modality and how it is offered.

Gina stated that at times she experienced issues with the technology both in the learning management platform as well the lack of social connections within the course:

> The only thing with BlackBoard Collaborate is that when you use it there's no visual . . . if we have all cameras on, we don't see each other—we just see the teacher on the screen. With no cameras on its kind of like a waste because no one sees each other. I found I preferred Zoom. It took a little bit of time to learn because I had to figure out like how to get it started . . . if it was an app or a website. As I was working on an iPad it was an application, but when I started using my computer, I learned there's no application for it and it's just a website and opens automatically.

Gina felt that she did well with the technological part of online learning, particularly since she had to use an iPad to take her courses due to her computer being not operational. Gina did not feel that the lack of technology was an issue for her being successful but did share that it took some ingenuity to master.

Christina, another traditional aged student, shared that it was not only the students in her class that struggled with technology, but she also found that at times the

technology affected the instructor of the course. Christina stated: “I knew he was trying hard . . . and was so sweet. It wasn’t that he was not knowledgeable . . . he just really did not know how to work the technology.” Yet, Christina stated that when she would communicate with the professor via email, he was quite responsive, getting back to her almost immediately. Her instructor was found to be very accommodating, and Christina felt that if her instructor were better versed in the online learning management systems that perhaps it would have helped her and her classmates: “Because if the instructors’ knowledge of technology was greater, in other words, if they had a better handle on some of the technology, I believe we would all succeed.”

When questioned as to what she felt would assist students in an online modality, Shaun noted the following: “I think maybe, I guess by putting people in groups it could increase the learning. Maybe assigning people to groups within the online course.” Shaun felt that these predetermined groups formed a community of learners that could assist all within the work group to succeed. Similarly, the shifting of teaching methodologies and knowledge assisted Gina in comprehension of the subject matter, which yielded better results for her.

Emily explained that as an older student she found that taking classes completely online required her to balance her schoolwork and her personal time. When asked about how she created this balance, she elaborated that she would create a weekly schedule, as well as a monthly one. This allowed her to know how to correctly schedule her time. She further went on to explain that there were times that her classmates would come to her for advice on how to be successful in an online class. Emily shared:

> One of my classmates, she was used to doing in person learning and then COVID hit, so now she was completely online. She's never dealt with online, so I was trying to help her out with it. Like trying to figure out her schedule and her planning and studying schedule. She was better with online after she had a plan.

Emily's ability to create success for another classmate was due impart to her self-discipline and ability to manage her time, allowing for ample study time and time to work on homework.

Time management was a common challenge that the student-participants revealed. Ruprecht supported this belief by sharing his struggle with time management and the strategies he implements to reduce these struggles:

> Time management, that is my biggest challenge is my time management skills. I have the luxury, I'm very lucky that my wife is incredibly supportive of me going back to school, as are my children, they're very supportive, and very respectful of the time that I spend . . . . You know, for me, being an older student and going back to school, I find I have so much more focus and passion than I did before. As far as time management, I feel like I did much better when the classes were on campus. Because then it made me It forced me to have to specify times where I wasn't going to be home, or times where I could, I would work at the library because it was more convenient.

Shaun explained that as a returning student she found that scheduling time to study was difficult the more classes she was taking in the online modality and felt that in many ways she needed to set aside blocks of time for studying:

> Last semester I set aside study time, I was able was able to work and study . . . this semester, my schedule overwhelmed me as far as studying was concerned . . . I have never taken four classes, all online. Last semester, I was able to set aside study time; I was able to do everything I was able to balance it all. And this semester, I am overwhelmed.

The ability to fit in blocks of time to accomplish schoolwork worked well for Shaun and assisted her to complete her coursework successfully. Gina shared the same views as the others in the need for planning to be successful in an online course. As a student that worked approximately 30 hours per week, she explained: “depending on my assignments for the week, I try to plan like, ahead of time when I’m going to do what around like roughly, along with my work schedule.”

Several participants discussed challenges related to focusing on their online courses. Gina explained that for her the connection within her online course was hindered by her inability to focus when faced with an online platform, sharing,

> I feel like when I take math classes I need to be in person because my mind naturally just wanders and there’s no reason for me to like stay focus because I feel like online, I can easily wander, and it'll be okay and go right back to it.

Gina also elaborated, “I feared it personally, I always asked you kind of looking forward to getting out of the basic math again, okay, because the developmental math was, like, easy for me, because I knew so much already.”

Several student-participants reported preparedness as an obstacle to their success. Emily shared that for her the transition into college from high school was a difficult one in that she felt that her preparation was lacking. Upon entrance to Pebbles Shores

Community College, she placed in both developmental Mathematics and English, which she felt placed her at a disadvantage. Emily tried to explain:

> It was a little confusing . . . originally for me, because going from my high school, which didn't really do much with education . . . we were told it was more like here, do it this way. Do this and pay attention as the other students were roughhousing.

She elaborated: "I feel like they could because if they were, let's say, they're good at math, but they're not good at reading English. That can make them not good at math itself, because they're not understanding the words." Emily upon entry to college was placed in two developmental subjects and stated that for her needing assistance in both mathematics and English added to the struggle of online learning. The ability to comprehend and correspond within an online course can be a greater challenge than that of a traditional course, which as Emily noted adds to the already challenging mathematic work.

As connection was important for the learning within an online course, the ability to use the technology features of the learning management system was important to learn, but just as important was the familiarity with the platforms for both the student and the teacher. Each student-participant shared that for them the knowledge of how the learning management system worked and the information gained was essential to the collaboration of both their professors and their classmates. Collaboration within OCL creates a connection and presence for the members of the course to discuss and elaborate on the lessons within, creating the concept of idea generation, which is one of the aspects of the theory. As all the student-participants shared, there needed to exist a way for the class

and their teacher to not only communicate in one direction but to share thoughts and ideas for the learning to be enhanced. Theme two, *connection*, finds its tie to the OCL theory in its relationship to the second phase of idea organizing. By employing technology, knowledge, and time management skills to generate interactions as part of a class, connection allows learning to be enhanced and embraced by all within the platform.

Commitment: Engagement, Motivation, and the Factor of Age. The final theme, identified as *commitment*, emerged from the interviews of the students as each interviewee elaborated on their philosophies and viewpoints about the form of commitment that existed within the online mathematics class.

Emily explained that for her, the engagement, a factor of commitment, can take on different forms by using technology. She stated that student engagement in the online modality can be achieved by using various forms of technology. Saying "I took an online course at a previous college on a different topic, and they actually use a video game to attend their classes, called Second Life," she explained that through this program the students were able to simulate a classroom experience. Emily believed that for her it assisted in the creation of a community of learners. In contrast, Gina expounded that the engagement she felt in her mathematics course in the online platform was like that found in a traditional classroom setting. This engagement Gina felt was due in part to the faculty member conducting the course with a real-time component: Zoom technology, which assisted the faculty member and the students to meet at specific times, like face-to-face traditional learning. Christina noted her view of engagement was found in direct communication with the professor and her classmates: "I think reaching out to the

professor and honestly trying to form relationships with other students that you can get help. Because I think with the class I had that engagement, that it really helped." Christina also shared that sometimes, it's easier for students to reach out and ask other students that are taking the same course if they comprehend a task "rather than emailing the professor like, five times a week when you don't fully get something." She further went on to explain that with all the social communication and engagement occurring via webcams and video it was difficult. She elaborated that not seeing students' cameras on swayed her use of webcams and video.

Status as a nontraditional or older student showed an impact on student-participants' views and experiences of engagement in their online courses. Ruprecht explained that for him a challenging aspect of the modality of the online class was his need to remember that it is important to continually engage with the faculty and his classmates. He explained that for him it was important to maintain contact with his instructor by purposely engaging the professor in office hours, which is not always "part and parcel to the course." He elaborated:

> Professor Bobbi, she doesn't just sit there and lecture; she's engaging. You know, she wants to get to know the students, she wants to help the students in a more holistic manner, that just teaching them the law of science. . . So regardless of the subject, I absolutely want everyone engaged. I understand that that's not going to be a possibility, depending on the course.

Ruprecht, as a nontraditional student, felt that when traditional students can engage that they often opt out. He shares that many of his classmates choose to leave the camaras off

if they have the ability in their online class. His thoughts are that this factors into their engagement in the course.

> The fact that you're not even willing to be on camera... are you even engaged? Or are you just showing up? Are you just turning your camera on and leaving, and you know, and now people are getting credit for attendance that they haven't earned?

Shaun a nontraditional student as well imparts her impression of the ability for students to shut down their video. She explains that when she does not know what you look like it affects her ability to connect to you.

Ruprecht explained that as an older returning student he was motivated by attainment of his goals and felt that this in many ways created a discipline for himself. For him the motivation came from within and assisted others in his class due to his nature of reaching out and guiding his classmates that were struggling. Ruprecht further goes on to explain his view of student success:

> It’s like anything else that I tell my kids, you know, the professor can only do so much, whether it's in the classroom or online, they cannot open the door for you, they can give you the key, they can show you the door, but ultimately, you're going to have to be the one to open the door.

His realization that motivation of the student is extremely important for student success, can assist faculty and higher educational leaders. Perhaps the key to online success is found in the motivation and reason for the student to complete the course. The further the student is invested in the course, the greater the desire to engage and complete.

Ruprecht, a non-traditional aged student, expounded that for him "It's very difficult to be engaging with the students because the little bit of communication you might get from them, you have no idea what the motivation is or what level of understanding or attention they've paid." He explained that the lack of connection that is sometimes created by the online learning modality and the inability to interpret that which is being communicated due to an inability to read body language and facial clues. He felt that when he was learning in a course where the professor was using technology such as Zoom, the lack of cameras being on created a barrier for him to communicate with others within his course. He further went on to share:

> When it comes to Professor Bobbi's class, I think people are more willing to share their lives because of personal connection they feel with her. In Professor Bobbi's class, there could be as much as a third of the students with cameras on. So, I feel like maybe I've even seen half the class on camera, which is just amazing. No, no other professor has yet to set up any kind of outside meeting group or chat group other than Professor Bobbi. They've encouraged . . . outside collaboration . . . I couldn't tell you honestly, that any professor has actively engaged the students to meet outside of the course.

For some students like Ruprecht, the engagement for the course comes from the communication that is assisted by the motivation that is seen within the course. Yet, Ruprecht noted that the engagement is correlated to the faculty member, and how much they support the use of outside methods for communication.

In contrast, as a traditional aged student Christina felt that her experience with taking an online mathematics class in high school perhaps assisted her in better

comprehension, allowing her to have a base of knowledge that she could build upon. Taking statistics prior in high school gave her a background in the subject and the online modality. Christina explained, "I thought it wouldn't be as hard for me to repeat this math class online in college. I thought it would be good to take it because I have a little bit of a background of it."

The student perceptions of the third theme, commitment, recognized that the belief that commitment was vital for learning within an online course. The subtheme of age combined with the other two subthemes of motivation and engagement created the commitment to the course. Research has identified that the non-traditional student achieve success in online learning due to their ability to commit and engage (Bailey & Morest, 2004; Rovai, 2003; Swan et al., 2009; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008). The non-traditional students shared that their motivation and ability to engage assisted them, as well as their classmates, in successful course completion.

As the final stage of OCL, *intellectual convergence* is created through the engagement of the class or group. The participants all shared that the formation of a leader at this phase was important for the learning. The commitment to the process and structure of the online platform, coupled with engagement, allows for the convergence of thoughts and ideas, thus creating the learning

Alignment of Themes to Research Question. When considering the three themes that emerged from the student-participant interviews and their connections to the theory from Chapter 2, the following aspects of the research have been noted. Theme one, collaboration, is linked within the theory as the concept of idea generation. The participation of the student, as well as the faculty, occurs within the online modality to

assist the participants in the creation of an online presence, communication, and the creation of social connections. A concept identified by the student interviews was that the ability to have a communication tool such as discussion boards or GroupMe, is helpful for the student, as was noted by Emily. Ruprecht found it to be necessary for the faculty also to create a teaching presence. This presence created by both the student and the faculty sets the stage for collaboration to be established.

Theme two, connection, ties into the OCL theory in its link to the second phase as idea organizing using technology, knowledge, and time management to generate synergies as part of a group. These three subthemes assist the student in an online course to establish comprehension as a member of the group. Shaun expanded on this point by suggesting that one way for faculty to form connections among students within a class is to "perhaps set up established cohorts of individuals that you can rely upon, that you could reach out and say, 'Shaun I missed the class, and we got a test in three days. I know I'm stuck on probability, could you assist me?'" Shaun felt that the instructor not only could evaluate the group assignments and projects throughout the semester but also could evaluate the students on their individual and group engagement: "The professor can give those individuals their grades, but then do something where the teacher would know, if that group worked well together, or if they are engaging with each other."

The third and final theme of commitment identifies with the engagement and motivation of the student for success in the online modality. As the student progresses through the phases of the OCL theory, they end at the stage of intellectual convergence. At this stage, the students are collaborating to create a shared outcome. To achieve this, the students must be not only engaged in the group, but they must be committed to the

process. As the interviews showed, the students that identify as nontraditional are more likely to complete the project and seek answers outside the course. All these factors assist the student in completion and student success.

Conclusion. Examining the perceptions gathered from the semi-structured student-participant interviews, the first theme identified found its roots in OCL theory. Harasim (2017) identified that collaborativism realizes that individual student learning can be enhanced through the employment of identified ideas of engagement, determination, and motivation for the student. Within the collaborativist learning theory one finds three key learning processes: (a) idea generation, where the learners brainstorm, verbalize, and share thoughts with each other; (b) idea organizing, where the learners begin to conceptually change in their thinking, thereby challenging each other and beginning to converge their thoughts, selecting the strongest or best ideas; and (c) intellectual convergence, where the learners create a shared understanding by integrating their ideas and knowledge forming well-defined points of view and positions, thus creating convergent thinking. The student-participants' experiences of collaboration during their online mathematics course indicated that the students identified a sense of connection within the class, whether to the faculty member teaching the class or to other students. This connection assisted the students in greater commitment to the course, their classmates, instructors, and materials.

CHAPTER 5

This dissertation explored the associations of academic and student characteristics for developmental students enrolled in a community college located in the northeastern United States, that enrolled in their first credit-bearing mathematics course online. The study explored the impacts of these characteristics on student success for developmental students that took their first credit-bearing mathematics course in an online modality. Looking to answer three research questions: the first quantitative analysis examined the predictive influence of demographic characteristics of age, gender, ethnicity, and socioeconomic status on successful course completion. Age and ethnicity were statistically significant in the successful course completion of the student, thus bearing further examination and validation from the third research question.

Second, the study investigated the predictive influence of academic characteristics of successful credit hours attempted, the number of developmental courses taken, and the number of credit hours awarded on successful course completion of developmental students enrolled in a college-level online mathematics course. Statistically significant results were found that the number of attempted credits taken, as well as the number of credits awarded were valid predictors in calculating whether a student successfully completed their first college-level mathematics course online, and thereby warranted further exploration as well in the third research question.

Finally, the study examined through qualitative discourse how students enrolled in a fully online mathematics course described their participation and engagement within their course. Three themes emerged from these interviews and document analysis: collaboration, connection, and commitment; these themes connected to each of the major

outcomes identified in the quantitative portion as they relate to the theoretical framework OCL presented in Chapter 2. The researcher also has linked discoveries of the current study with previous literature, reviewed in Chapter 2. This chapter will provide a discussion of the limitations of the current study and suggestions for future practice and research.

Discussion of Findings

The goal of the study was to examine students' participation and collaboration within an online mathematics course, as it factored into course completion success. By looking to determine if this success was associated in any way with demographic and academic characteristics identified in the quantitative questions of the study, and then examined through the theoretical lens of the OCL theory. This current study assessed how the students experience of collaboration during their online mathematics course could identify an awareness of connection within the course to the faculty member teaching, or to other students within, thereby creating a community of learners (Shea et al., 2005; Shea et al., 2006; Swan et al., 2009), noted by research to assist students.

The findings that were significant for the quantitative portion of the first research question found that age and ethnicity influenced whether online developmental learners completed the course, which correlated to the research (Aragon & Johnson, 2008; Bailey & Morest, 2004; Rovai, 2003; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008), and were noted to exist in the qualitative portion as well. The study found that the older the student, the more probable their success, showing that increased age at enrollment is a characteristic that enhances successful course completion (Cochran et al., 2014), also appearing to be relevant in part to the academic standing of the student and the courses

they have completed. As the number of non-traditional students within community colleges continues to increase, the necessity for learning communities that are collaborative and engaged also increases (Ellis, 2019; Ziegler et al., 2014), and thereby stipulates online learning modalities that can fulfill these needs. Note, the first research question quantitatively observed that ethnicity was an indicator of successful course completion. Given the constructs of the investigated demographic variables, I was unable to determine more. The qualitative inquiry as well did not also possess any descriptions speaking to this from the participants.

Analyzing the results for the second research question revealed the number of attempted credits taken by students as well as the number of credits awarded toward degree completion were noteworthy predictors in forecasting whether a student would successfully complete their first college-level mathematics course online. It emerged that the number of credits a student had completed increased the probability of success for these developmental mathematics students enrolled in an online course. Consideration of the quantitative results for the 217 developmental mathematics community college students in this study identified that students who had successfully completed 55 credits or more were significantly more likely to successfully complete an online course, leading the researcher to further explore these results qualitatively. The qualitative exploration identified that students with a greater number of credits awarded identified that commitment to their studies factored into their successful completion in the online modality. Insomuch as the academic standing and advanced status of these non-traditional students increases the motivation and desire to complete their online course, it creates a greater probability that they would finish successfully (Cochran et al., 2014).

Another outcome of my quantitative results showed the number of awarded credits towards degree increased the likelihood that a student successfully would complete their first college-level mathematics course online, seeming probable that the advanced standing and closeness to completion for a student creates a motivation towards completion.

Considering the themes (collaboration, connection, and commitment) that emerged from the qualitative inquiry, I contemplated how each theme enhances the understanding of a student's performance in an online course. These three themes aligned with the research and the OCL theory that spoke about the importance of the creation of a knowledge community (Harasim, 2017), as the student-participants identified a virtual connection and community. This connection to other members of the course assists students to engage in the learning and overcome the perceived isolation of the online learning modality. I, discovered that the final stage of Intellectual Convergence (IC), brings about a possible application that is created through group interaction within the OCL theory. Learners create a shared understanding by integrating their ideas and knowledge into comprehensible views and positions. I identified that these student characteristics and the collaboration created within this online mathematics course assisted the student to engage and participate in the online learning modality and create successful outcomes.

The three classified subthemes enriched the quantitative results, as this study used an explanatory sequential design which looked to elaborate on the quantitative results with qualitative discourse.

The first theme, collaboration, observed the existence of presence, social connections, and communication. This theme examined what occurs from the viewpoint of the student, when they enrolled in a completely online mathematics course at Pebbles Shores Community College. The concept of a virtual presence that has both student and faculty within expressed success, as each group strives to create an existence in the online educational modality. The subtheme social connections explained by the student-participants asserted a need for bonds and connections, as these students looked for relationships to strengthen their learning (Richardson & Swan, 2003; Swan et al., 2009). Several student-participants explained how the social connections enhanced their understanding and factored into idea generation, the first phase of OCL. Communication was identified as the students having multiple ways to interact with each other and the instructor using chatrooms, discussion boards, and other electronic communication. These various methods for communicating were seen at times by the student-participants to be unclear or unproductive, causing me to contemplate ways for faculty to advance the learnings within the modality, to be discussed further in the implications for practice section.

The second theme, connection, examined the contribution and involvement by the student within the course, incorporating the learning management platform employed the classroom modality features and how the course and the material are offered to the student. This theme examined technology, knowledge, time management skills, and obstacles, as these affect the modality and effect the course and how it is offered. The subtheme technology refers to the student's and instructor's familiarity with online learning and showed that high school experience, comprehension, exposure to software

programs, and understanding of learning management system enhance the acquisition of student knowledge. The subtheme of knowledge emerged, noting that the familiarity of the online learning platform played a role in successful experiences and completion of tasks assigned and related to the concept's education, learning, and mastery of the subject matter. The interviews showed that the student-participants interviewed acknowledged the need for and importance of time management skills for success in the online modality, particularly in relationship to life balance, scheduling, and self-discipline. It was discovered within the interviews that non-traditional students had a greater sense of self-discipline and its importance in an online course. Finally, the student-participants identified obstacles as barriers needing to be overcome, and they shared that mathematics anxiety and developmental coursework were prevalent. All the students valued the online learning methodology and shared how it affected their performance and success as a student.

The final theme identified from the interview analysis is commitment, which identified that the amount of time, energy, and dedication a student places in their studies correlates to their success. This theme shows that engagement, motivation, and age significantly affect a student's performance. This theme demonstrates how students view and act in accordance with the requirements and expectations of their studies, and the requirements and expectations of the instructors within the online modality. Engagement entails how involved both verbally and in the written format the student is with their studies and is demonstrated by both student and teacher. Motivation is characterized as how inspired and driven a student is to complete their studies and reflects the student's desire to engage and participate in the online modality. Motivation of the student looks at

the future, as the drive that the student experiences often occur due to their career plans. Age factor of the student is the age the student was when enrolled in the online mathematics course; as the research shows, age plays a role in the motivation and determination of the student (Bailey & Morest, 2004; Rovai, 2003; Swan et al., 2009; Tinto, 1975, 1993; Wladis et al. 2016; Zeidenberg, 2008). Age factor is identified for this study as non-traditional and traditional and appears to be significant throughout all three themes.

Limitations of the Study

As the research was conducted using only one online course in mathematics, the results might differ if the researcher looked at a different mathematics course or a perhaps a completely different discipline such as an online introductory English course. Each online mathematics course may have different learning objectives and outcomes, and therefore may have different pathways to completion, and each instructor within this institution studied, may have various requirements for completion and student success. As there were several instructors that taught this college-level mathematics course analyzed, these differences must be acknowledged when comparing course completion and student success. Higher educational institutions should understand the implications of such a limited sample and should view and account for the variations to properly forecast student success. This study was conducted with a convenience sample and therefore is only able to be generalized to the community college students directly related to this study; the ability to forecast these results will be difficult and unattainable (Creswell & Gutterman, 2019).

The size of the sample for the qualitative study was small, and therefore the research findings may only be illustrative of a unique set of perceptions or outcomes. The themes that were identified could be unique to Pebbles Shores Community College and the students that participated, and these themes may be difficult to expand to other institutions or students. Since this study was conducted with a convenience sample, it therefore will only be able to be comprehensive to the community college students directly related to this study and cannot be stated with confidence to be demonstrative of the population (Creswell & Plano Clark, 2018). As well, the demographic data collected were gathered through information self-identified by the student upon entrance into Pebbles Shores Community College, and as such cannot be cross checked for accuracy or correctness; this may affect the outcomes for the quantitative portion. This case study was conducted using only one 2-year multi-campus community college in the Northeast, and as such, the results may not be transferable to other regions or differing institutional types (Creswell, 2013).

Finally, I identified the students above the age of 25 years within this study as non-traditional, which followed in the literature and research that distinguished these students based on characteristics of age and student course completion. There is a growing conversation that non-traditional should be called post-traditional and in future research perhaps the post-traditional term could be used. This new student demographic classification encompasses more and is a more realistic term to describe the student.

Implications for Practice

Communication was acknowledged by the student-participants as being an important part of the online course experience. Several students identified that having a

method to interact with each other and the instructor assisted them in understanding the subject matter. Future practice should focus on the creation of a unified communication method that will assist both the student and the instructor. The use of discussion boards and other electronic communication methods has been examined in this study and noted to be important for engagement and participation, but if these communication venues are not used or incorporated, confusion can exist as the student-participants in this study noted. Various methods for communicating were created by the students outside the learning management platform, as all the student-participants noted. The creation of these communication systems can create confusion as they are not monitored by the instructor or the higher educational institution. Some of the student-participants expressed their desire for these systems within the learning management system to assure that they were receiving correct and clear information from their instructors.

A second practice that should be applied is that faculty should be trained through professional development to advance their learnings and knowledge of the online modality, thereby increasing the opportunities for engagement and collaboration for students and with students. As faculty create online communities of learners, it will assist the student to participate and grow assured that there is a resource available for them. The OCL theory identified the creation of these communities adds to the idea formation and eventually the convergence of ideas. One student-participant shared that perhaps the instructor of an online course could form predetermined communities of learners. These work groups could be set up in advance and be un-graded to allow the student to engage with members of their class without concern as to how these classmates will affect their grade, thereby allowing unfettered communication, engagement, and participation.

Perhaps the expansion of the qualitative inquiry to include a survey administered to more students and including faculty would expand the results and further explore the concept of collaborative development on all levels within the online course.

Implications for Research

As the first quantitative question of this study identified, ethnicity was a significant predictor for success of developmental students enrolled in an online mathematics course, yet the constructs of the investigated demographic variables did not confirm these results. It would be beneficial and recommended for further research to analyze the extent to which ethnic origin was a factor related to online course completion.

The inclusion of different disciplines and teaching methods would allow the research to increase in its ability to determine if the demographic and academic characteristics variables would carry through to another academic subject or pedogeological method, and still hold its ability to predict course completion. Perhaps recasting the study using other community colleges, would allow for the research results to be tested for transferability to other institutions.

The findings of this study can be used by higher education faculty and administrators to assess and create best practices for pedagogy within the modality of online course offerings. By identifying student characteristics that speak to successful online completion for developmental mathematics students, courses can be created that bridge the gap between student success in the classroom and student success online. The result of this study points to the need for future research in identifying student characteristics which may assist both students and leaders in increasing successful course completion.

As the non-traditional student within this study has been identified as possessing not only the student characteristics but the motivation for successful course completion within the online modality, further research is needed to expand on measures that institutions can establish to assist in their success. Perhaps the development of faculty in online teaching modalities warrants further assessment and research to understand the necessity of the development of a community of learners (Garrison et al., 2000), as noted in OCL theory (Harasim, 2017), that allows for the student and the instructor to develop rapport and engagement. As the OCL theory is included further within online courses both faculty and students will grow in the engagement and connection. Faculty and institutions need to research ways to increase the connection and engagement for all. The illustration (Figure 1) of a knowledge community illustrated the development that both students and teachers follow in the learning process and exemplified the theory and some of its components. Further research should occur to examine the correlations between the online learning platforms and Harasim's OCL theory, to determine how the theory and the practice align and create collaboration for the student. By higher educational institutions working towards the identification and inclusion of collaboration and communities of learners in online teaching modalities perhaps we can identify more pathways for students to learn and succeed.

Conclusion

This study adds to the body of literature regarding the creation of a community of learners within an online mathematics course as being essential for students to succeed. Community colleges are being asked to address more societal and economic needs and must continue to provide open access for all students to attend. Given this fact, we have

seen the landscape of higher education change from more traditional face-to-face courses to completely online through technology adoption, creating a gap for both the student and the institution to address. As the research shows, the online modality for learning although still being analyzed for its effectiveness, has become a viable source for education. Community colleges must continue to gauge whether the modality of online learning is a fit for the student and the institutions that offer it and must create pathways for success. Research has shown, community college students select online courses for many reasons (Jaggars, 2013; Swan et al., 2009), and as such it is imperative that leaders of these institutions continue to provide pathways for these students' success.

Creating training for faculty in online course development and design, institutions of higher education will assist both the student and the faculty, and thereby enhance the opportunities for all. The quantitative portion identified that community college students that had completed a significant portion of their needed coursework were more apt to advance and complete an online course, perhaps because of the commitment and motivation identified as a theme within the qualitative portion.

A further outcome discovered from the qualitative portion of this study elaborated students' need for collaboration, as they described the necessity and the ability to create a community of learners within the online classroom (Garrison et al., 2000; Lawson, T.M., 2019; Swan et al., 2009; Swan, 2002). This community of learners has the potential to address the isolation and the disconnect experienced by both student and instructor. As research shows, students can be successful, we just need to identify where we can assist them, to learn and grow. Whiteside (2015) identified the faculty's importance in social presence "as a master conductor that synchronizes the instructor, students, norms,

academic content, learning management system (LMS), media, tools, instructional strategies, and outcomes within a learning experience" (p. 11). When one compares online learning to traditional face-to-face coursework for the presence of engagement of both the student and the instructor, the research points to formation of engagement being created through components of the learning management system that are rooted in the OCL theory. The research has validated that social presence affects not only results for students but possibly an instructor's fulfillment derived from teaching a course (Swan, K., 2002). Improving the successful outcomes for community college students within an online modality can assist higher educational leaders to create pathways for developmental students to succeed within an online course.

APPENDIX A

Participant Consent Form

ST. JOHN'S UNIVERSITY

Investigator:
Name: Mary Monica Ryder
Institution: St. John's University
Phone Number: [redacted]
Email: [redacted]@stjohns.edu

Purpose:
You are invited to participate in the research project entitled, Course completion and perceptions of community college developmental students enrolled in online mathematics coursework. This research is being conducted to identify if there are any demographic or academic characteristics for online student success for developmental math learners. You are eligible to participate in this survey if you identify as a developmental math learner.

Description of Procedures:
Participation is through the completion of a 45-minute interview with the investigator. I will be asking you questions about your understanding and experiences in online learning. If you are interested, you will only have to participate in one 45-minute interview session with the investigator.

Participation & Confidentiality:
Your participation in the research is completely voluntary. Refusal to participate will involve no penalty or loss to you. You may terminate your participation at any time. Your interview responses will be confidential. Only the principal investigator will have access to the information you provide. Any information obtained from this study will be used for educational purposes specific to the above dissertation but will not identify project participants in any way and no identifiable information will be used.

Risks:
There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can skip any questions which make you uncomfortable. You can also completely withdraw from the study at any point.

Benefits:
There are no direct benefits to participating in this project. However, your participation will benefit this study in that you will be informing research about your experiences related to online mathematics coursework and course completion. This research might help postsecondary administrators prepare and support developmental math learners in the online modality today and in the future.

Contact Information:
If you have any questions or problems concerning my participation in this study, please contact me directly
Mary Monica Ryder @ [redacted]mystjohns.edu
Or if necessary, my advisor Dr. Katherine C. Aquino at [redacted]stjohns.edu.

Statement of Consent:
By signing below, I agree to participate in this project.

_____ _____
Sign Name Date

_____
Print Name

In addition to consent to participate to this project, I agree to be (audio/video) recorded.

_____ _____
Sign Name Date

_____
Print Name

APPENDIX B

Demographic Information

1. Gender
_____Male _____Female _____Other

2. Age
Please circle one answer.

16-19
20-23
24-27
28-31
Over 32

3. Ethnic Origin
Please circle one answer
American Indian
Asian or Pacific Islander
Black, not of Hispanic origin
Hispanic
White
Other

4. Educational Status

_____ Fulltime _____ Parttime _____ Other

5. Experience Online
Please circle one answer.

No courses taken before this first college-level math course
One course taken before this first college-level math course
Two to Four courses taken before this first college-level math course
Five or more courses taken before this first college-level math course

6. Number of developmental math courses taken
Please circle one answer.

No courses taken before this first college-level math course
One course taken before this first college-level math course
Two to Four courses taken before this first college-level math course
Five or more courses taken before this first college-level math course

APPENDIX C

Semi-Structured Interview Questions

1. Can you tell me a little bit about yourself and your education to date?

   a. What brought you to this institution?

   b. What are your educational goals?

   c. What are your career goals?

2. Tell me about the courses you have taken and are taking this semester.

   a. What other courses have you taken online?

   b. Did you take these online classes before your first college-level mathematics course online?

3. Why did you take *MAT 103* online instead of face-to-face?

   a. Did you talk to anyone who had taken the course online before you registered to enroll?

   b. Were you advised by an advisor or faculty prior to registration?

   c. Did you take it online due to your personal schedule/or lack of course time offering to match your availability?

4. Tell me about the work expected for this course.
   a. What did you like about the content and why?
   b. What assigned tasks were easy to understand and accomplish? What assigned tasks were challenging to you?

   c. Was there any part of the online course you could not handle?

5. How well did you plan your time to study and work online each week?
   a. Were you successful? How did your study/work plan turn out?

6. Did you form any relationships with other students in the course?

   And how was that accomplished in the course?

   a. If yes, did these social connections help you toward success?

b. If not, did the lack of social connections hold you back in completion?

7. Would you take an online mathematics course in the future?

8. Do you believe you were successful in this online college-level mathematics course?

9. What was your perceived success in this online college-level mathematics course? And would you be comfortable share the grade you received?

10. In your opinion what would have improved this online college-level mathematics course? Any advice for other students?

11. What questions do you have for me about this study?

APPENDIX D

IRB Approval From St. John's University

From: [redacted]@stjohns.edu <[redacted]@stjohns.edu>
Sent: Friday, December 18, 2020 4:11 PM
To: [redacted]@stjohn.edu <[redacted]@stjohn.edu>; Mary M. Ryder <[redacted]@my.stjohns.edu>
Subject: IRB-FY2021-217 - Initial: Initial Submission - Expedited - St. John's

Federal Wide Assurance: FWA00009066

Dec 18, 2020 4:11:30 PM EST

PI: Mary Ryder
CO-PI: Katherine Aquino
Ed Admin & Instruc Leadership

Re: Expedited Review - Initial - **IRB-FY2021-217** *Course completion and perceptions of community college developmental students enrolled in online mathematics coursework*

Dear Mary Ryder:

The St John's University Institutional Review Board has rendered the decision below for *Course completion and perceptions of community college developmental students enrolled in online mathematics coursework*. The approval is effective from December 18, 2020, through December 17, 2021.

Decision: Approved

PLEASE NOTE: If you have collected any data prior to this approval date, the data must be discarded.

Selected Category:

Sincerely,

Raymond DiGiuseppe, PhD, ABPP
Chair, Institutional Review Board
Professor of Psychology

Marie Nitopi, Ed.D.
IRB Coordinator

APPENDIX E

Modified IRB Approval From St. John's University

Federal Wide Assurance: FWA00009066 Mar 22, 2021 4:32:41 PM EDT
PI: Mary Ryder
Dept: Ed Admin & Instruc Leadership

Re: Modification - IRB-FY2021-217 Course completion and perceptions of community college developmental students enrolled in online mathematics coursework

Dear Mary Ryder:

The St John's University Institutional Review Board has rendered the decision below for Course completion and perceptions of community college developmental students enrolled in online mathematics coursework.

Decision: Approved

Sincerely,

Raymond DiGiuseppe, PhD, ABPP Chair, Institutional Review Board Professor of Psychology

Marie Nitopi, Ed.D.
IRB Coordinator

APPENDIX F

IRB Approval From Site Institution

To: Mary Ryder
Adjunct Associate Professor

[redacted]@[redacted]edu

From: Courtney Brewer, Co-chair Institutional Review Board

[redacted] Community College

[redacted]@[redacted].edu

[redacted]

1/14/2021

Re: Course completion and perceptions of community college developmental students enrolled in online mathematics coursework

Dear Mary,

After a review of your protocol, it was the decision of the Board that the study meets the federally designated criteria for an IRB exemption under category 45 CFR 46.101(b)(3). Your proposal has been granted authorization. Please note the following information:

- **IRB# 20-019**
- **Expiration Date: 1/14/2022**

Please note that changes to the protocol must be reported to the IRB immediately and that such changes may warrant a new review. An adverse event is any instance which places participants at risk or at a level or degree of potential harm outside of those indicated within the initial protocol. Should such an event occur, the College IRB must be notified within 48 hours of the event. This information will be forwarded to the Vice President for Planning and Institutional Effectiveness as well as to the Office for Human Research Protection.

Upon receipt of the adverse event report, the co-chairs of the IRB, in consultation with other members and administrators as appropriate, will require immediate suspension of the activity prior to review by the full membership.

Should you have any questions, feel free to contact either myself or my co-chairs, Dr. Helen Wittman and Rachael Millings.

Sincerely,

Dr. Courtney Brewer
Associate Professor
Co-chair, Institutional Review Board [redacted]@[redacted].edu [redacted]

Rachael Millings
Assistant Professor
Co-chair, Institutional Review Board [redacted]@[redacted].edu [redacted]

Dr. Helen Wittmann
Assistant to the Vice President
Co-chair, Institutional Review Board [redacted]@[redacted].edu [redacted]

APPENDIX G

Identification of the Quantitative Variables Used in the Binomial Logistic Regressions

Name	Description	Type	Original Coding	Recode Name(s)	Coding Structure
AGE	Student's age-composite	Categorical	0 Traditional 1 non-Trad	Traditional/Non-Traditional	0 Traditional 1 non-Trad
RACE_DESC1	Student's race/ethnicity-composite	Categorical	0 Non-White 1 White	Ethnicity	0 Non-White 1 White
PARTICIPANT_ GENDER	Student's sex-composite	Categorical	0 Male 1 Female	Gender	0 Male 1 Female
PELL	Student's socioeconomic-composite	Categorical	0 No 1 Yes	Socioeconomic Status	0 Not Awarded 1 Awarded
TOTAL_ CREDITS_ ATTEMPTED	Students' number of credits taken-composite	Continuous	None	Credits Attempted	None
DEVMATH	Student's number of credits taken-composite	Categorical	0 One Course 1 More than One	Dev Math Taken	0 One Course 1 More than One
TOTAL_ CREDITS_ PASSED	Student's number of credits taken-composite	Continuous	None	Credits Awarded	None
FINAL GRADE	Student's final grade-achieved	Categorical	0 non-Successful 1 Successful	Successful Course Completion	0 non-Successful 1 Successful

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