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The Predictability of Personal, Academic, and Service Rated Factors on Perceived Academic Success in Mathematics of College Students.

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THE PREDICTABILITY OF PERSONAL, ACADEMIC, AND SERVICE RATED FACTORS ON PERCEIVED ACADEMIC SUCCESS IN MATHEMATICS OF COLLEGE STUDENTS

DISSERTATION

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THE PREDICTABILITY OF PERSONAL, ACADEMIC, AND SERVICE RELATED FACTORS ON PERCEIVED ACADEMIC SUCCESS IN MATHEMATICS OF COLLEGE STUDENTS

By

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In recent years, student completion of the first-year and second-year college curriculum has become a significant barrier to student success and retention especially at Historically Black Colleges and Universities. Despite low pass and retention rates, many degree programs in the U.S. require at least one college-level mathematics course, and the failure in this math course has contributed disproportionately to the failure to complete the first and second year curriculum. The purpose of this study was to examine the predictability of the relationship between selected personal, academic, and service-related factors and the perceived academic success in mathematics among college students. Specifically, this study was concerned with the predictive power of the variables gender, ethnicity, course schedules, degree program, type of instructional method, tutoring, advisement, and faculty mentoring on the perceived academic success in math among college students. Participants were selected from two higher education institutions located in the southern region of the United States, and they were also administered a Modified Version of the Mathematics Attitudes and Perceptions Survey. A correlational

research design was utilized in the present study that allowed the researcher the opportunity to examine the relationship and predictability between two or more predictor variables and one criterion variable.

It was expected that selected personal, academic, and service related factors do have some predictive validity with respect to the academic mathematics success of college students. Also, it was expected that service related factors would contribute to the predictability of the perceived academic success in math among college students.

Several findings were obtained from the results of this empirical investigation. First a linear relationship was found to exist between the personal related factors of gender and ethnicity, academic related factors academic major, college readiness, traditional instructional method and online instructional method, and the perceived academic success in mathematics among college students. Second a statistically significant linear relationship was not found to exist between the service related factors of tutoring, cooperative learning, and the perceived academic success in mathematics among college students. Finally, the service-related factor of cooperative learning was found to be independently related to the perceived academic success of college students in mathematics.

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DEDICATION

I dedicate this doctoral dissertation to my mother, Catherine Fletcher, and my daughter Christina, my two grandsons Kristian and Tyriq, and all my family members who have provided me love and support throughout the years. A special thanks to my dissertation committee members - Dr. Danita Bailey-Samples, Dr. Ronnie Davis, Dr. Jay Cummings, and Dr. Ronald Samples - to whom I owe a special gratitude. Their guidance, professionalism, and unbridled support, have been invaluable during my time as a student and in the final stages of my research.

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CHAPTER 1

INTRODUCTION

In recent years, student completion in the first year and second-year college mathematics curriculum has become a significant barrier to student success and retention. Despite low pass rates, many degree programs in the United States require at least one college-level mathematics course (Jaster, 2013; Ngo & Kwon, 2014). For example, college algebra is a course embedded in every degree plan in Texas' four-year and two-year colleges and universities. At these institutions, nearly half of the students enrolled in college algebra fail, withdraw, or receive incompletes due to several reasons.

One entry-level math course that serves as a core prerequisite is college algebra (Nguyen, 2014). Students enroll in college algebra based on several factors such as completion of a remedial mathematics program, completion of algebra I and algebra II in high school, college placement exam scores, or standardized aptitude tests scores (Wilder, 2013; Yuen, 2014). Scholars nicknamed college algebra as a gateway course due to its requirement in numerous undergraduate degree plans (González-Muñiz et al., 2012; Reyes, 2010; Zhang, 2014). This epithet stems from the high number of students who receive a grade of D or F (González-Muñiz et al., 2012) or withdraw from the course-abbreviated as DFW (Zhang, 2014). Research documented the nationwide DFW rate as high as 50%, while several institutions report a considerably higher rate (Scott-Clayton, Crosta, & Belfield, 2014; González-Muñiz et al., 2012). The American Mathematical Association of Two-Year Colleges (2006) reported consistent results concerning low college algebra success outcomes at large 4-year as well as small 2-year institutions.

Low success outcomes have costly effects on the student as well as the institution. Students pay large amounts in tuition to repeat courses and often transfer or withdraw from the institution out of frustration (Nguyen, 2014). These actions affect the institution's retention and graduation rates (Peters, 2013). For example, Wilder (2013) attributed the success of incoming freshman in a first-year math course to increased college retention rates. Reyes (2010) supported similar results in a study that associated unsuccessful outcomes in a college algebra course with institutional dropout or transfer rates. The findings from the results of these two researchers laid the ground work for this study; in regards to what possible service related factors are associated with the perceived academic success in mathematics among college students.

Skemp (2006) distinguished two different types of understanding in school mathematics: relational and instrumental understanding. Relational understanding implies that students know what to do and why, whereas instrumental understanding indicates that students know rules without reason. Mewborn (2007) stated that each student's mathematical understanding and problem-solving ability is primarily shaped by the teaching experiences encountered in school.

Statement of the Problem

The purpose of this study was to examine the predictable relationship between selected personal, academic, and service-related factors and the perceived academic success in mathematics among college students. Specifically, this study was concerned with the predictive value of the variables gender, ethnicity, academic major, college readiness, type of instructional method, tutoring and cooperative learning for the perceived academic success in math among college students.

Moreover, answers to the following questions were sought:

- Do personal related factors (gender and ethnicity) have any predictive validity with regards to perceived academic success in mathematics among college students?
- Do academic related factors (academic major, college readiness, and type of instructional method) have any predictive validity with regards to perceived academic success in mathematic among college students?
- Do service-related factors (tutoring and cooperative learning) have any predictive validity with regards to perceived academic success in mathematics among college students?

Statement of the Hypotheses

The following alternative hypotheses were formulated from the purpose and research questions:

H_1: There is a statistically significant relationship between personal related factors (gender and ethnicity) and the perceived academic success in mathematics among college students.

H_2: There is a statistically significant relationship between academic related factors (academic major, college readiness, and type of instructional method) and the perceived academic success in mathematics among college students.

H_3: There is a statistically significant relationship between service-related factors (tutoring and cooperative learning) and the perceived academic success in mathematics among college students.

Significance of the Study

The significance of this study was threefold: First, the present study provides pertinent data on the significant association between personal characteristics of college students and their academic performance in mathematics. By being able to identify the personal characteristics of these college students who are not successful in math courses, the institution will be able to develop programs to assist them in enhancing their academic performance in mathematics.

Secondly, this study provides college administrators, particularly those responsible for the academic preparation of students, with relevant data on the amount of predictive power that academic characteristics associated with math performance have on how college students perceived this relationship between preparation and success. Determining the degree of impact that academic characteristics have on the perceptions of college students toward mathematic courses will go a long way in developing instructional strategies to improve the academic performance of students in this area of study.

Finally, this study enhances college administrators' level of awareness of how student support service factors influence the academic achievement of college students in mathematics related courses. By understanding how these factors are related administrators on college campuses can develop insight into the type of service support college students will need to navigate mathematics courses, particularly at the freshman and sophomore levels.

Theoretical Framework

The present study was based on the Symbolic Interaction Theory and the Social Cognitive Theory. Both of these theories are very useful in explaining how personal,

academic, and service characteristics can predict how college students perceive their success in an academic course such as mathematics.

The Symbolic Interaction Theory argued that, through Social Interaction of Symbols and Symbolic-Communication such as language and gestures, college students will form concepts, ideas, and meaning that affect their academic behavior in mathematics (Wallace & Wolf, 1995). Specifically, this theory emphasized that a college student's perception of self and the role that his or her perception play in a mathematics class is greatly impacted by others.

Moreover, this theory can denote the importance of a college student's sense of understanding and commitment to being successful in math. Thus, it is expected that college students who can perceive themselves as being successful in mathematics will develop the academic skills necessary to perform successfully in this academic course. Also, it is expected that college students will enhance their knowledge of mathematics by participating in student support services at the institution, which are designed to assist them in being successful in this academic area.

Furthermore, the Social Cognitive Theory opines that new knowledge is built upon previous knowledge (Bransford, Brown, & Cocking, 2000). Vygotsky, who is a proponent of this theory, believes that concept formulation and communication are vital components to understanding mathematics. Consequently, the types of communication in which college students are involved in their mathematics classrooms to a large extent influences the cultural meanings they develop toward mathematics. In addition, the development of these mathematical meanings help them to create their own knowledge as they learn to explain and think about how to be successful in mathematics.

Assumptions

The study was developed and designed within the framework of the following assumptions:

- It was assumed that personal, academic and service-related factors associated with college students do have some predictive power with regards to the perceived academic success of college students in mathematics.
- It was assumed that the modified version of the Mathematics Attitudes and Perceptions Survey will accurately measure the perceptions of college students regarding their success in mathematics.
- It was assumed that lower level undergraduate college students who are enrolled in mathematics classes do have some understanding of those factors that impact how they perceive their success in mathematics.
- Finally, it was assumed that the perceptions of lower level undergraduates at the target institutions represent to a large extent the perceptions of undergraduates at similar institutions of higher learning.

Limitation and Delimitation

The following limitations were observed in the present study:

- The study was limited to lower level undergraduate college students.
- The study was limited to college students attending two institutions of higher learning located in the southern region of the United States
- The study was limited to undergraduate students enrolled in mathematics classes during the 2020 academic school year.
- The study was limited to data collected through the use of a survey.

- Finally, generalizations drawn from the results of this study were limited to lower level undergraduate students enrolled in similar mathematics classes.

Definition of Variables/Terms

The following variables and terms were operationally defined for this study:

- Academic Characteristics - refers to those aspects of an institution of higher learning which support the cognitive attributes of a college student. This variable is measured by academic major, college readiness, and type of instructional method.
- Academic Major - refers to whether a college student is in a STEM or Non-STEM program.
- College Readiness - refers to whether a college student perceives his or her math curriculum in high school as being effective in preparing for academic success in mathematics.
- College Student - refers to a student receiving academic instruction in a four or two-year institution of higher learning.
- Cooperative Learning - refers to whether a college student perceives working independently or working in groups in his or her math class as being the most effective in contributing to academic success in mathematics.
- Ethnicity - refers to whether a college student's self-identified ethnic status is African American, White American, Asian American, Hispanic American, or other.
- Gender - refers to whether a college student is male or female.

- Institution of Higher Learning - refers to an academic institution that offers its student clientele an Associate degree, Bachelor's degree, graduate degree, and/or a professional degree.
- Lower Level Undergraduate Student - refers to a college student who is classified as a freshman or a sophomore.
- Perceived Academic Success in Mathematics - refers to the mental disposition of college students regarding their academic success in mathematics.
- Personal Characteristics - refers to those aspects of college students that identify their demographic attributes.
- Service Characteristics - refers to those aspects of an institution of higher learning that provide support services to a college student to promote success in college. This variable is measured by tutoring and cooperative learning.
- Tutoring - refers to whether a college student receives tutoring in his or her math class in college.
- Type of Instructional Method - refers to whether a college student perceives the lecture, online, or hybrid instructional method as the most effective in contributing to academic success in mathematics.

Organization and Remainder of the Study

The study consists of five chapters. Chapter 1 presents the Introduction to the Investigation, the Statement of the Problem, and the Significance of the Study. In addition, the Theoretical Framework, Hypothesis, Assumptions, Limitations and the Operationalization of the variables are also discussed.

Chapter 2 identifies and discusses the related literature pertaining to perceptions of college students toward being successful in mathematics. This chapter also examines

the impact of personal, academic, and service-related factors on the perceptions of college students regarding mathematics success.

Chapter 3 describes the methodology framework including type of research design, population and research setting, sampling procedures, instrumentation, and validity and reliability of the instrument. Also, this chapter discusses the data collection procedures, pilot test, null hypothesis, statistical analysis, and the assumptions associated with the statistical test utilized in the study.

Chapter 4 consists of the data analysis section of the study. This chapter presents the data in a tabular form including statistical interpretation.

Finally, Chapter 5 provides a summary of the study, along with the findings and discussion sections. In addition, the conclusions, implications, and recommendations sections are also included.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Mathematics plays a major role in higher education as skill in mathematics is particularly essential to the development of the analytical thinking of students. Effective academic support services, course delivery formats, and classroom techniques for students enrolled in mathematics coursework at the post-secondary level are essential, especially with respect to success in mathematics. Mathematics placement is based on American College Testing (ACT) scores or Scholastic Aptitude Test (SAT) scores. Lack of preparation, particularly in mathematics, has the greatest impact on students majoring in STEM, as these programs generally require that students take at least one semester of calculus, and Calculus I is the required freshman mathematics class for STEM majors at many schools (Bahr, 2010). The declining number of students prepared to succeed in a college level calculus class in their freshman year reduces the pool of students likely to graduate with a STEM degree in four years (Kreysa, 2006). There are several damaging and pervasive myths about mathematics learning in the US that are believed by millions of school children, their parents, and their teachers. These different myths hold students back daily and reduce their learning and achievement significantly (Boaler, 2016). One of the most damaging is the idea that some people are born with a "math brain" and some are not, and that high achievement is only available to some students.

The purpose of this study was to examine the predictability of the relationship between selected personal, academic, and service-related factors and the perceived academic success in mathematics among college students. Specifically, this study was concerned with the predictive power of the variables gender, ethnicity, academic major, college readiness, type of instructional method, tutoring, and cooperative learning for the perceived academic success in math among college students.

Mathematics occupies a prominent place in the college and university curriculum, and success in mathematics courses is imperative in this age of rapid scientific and technological developments. Research has shown that student engagement in mathematics plays a key and pervasive role in human endeavors such as in the acquisition of mathematical skills and knowledge, course selection, educational pathways, and later career choices (OECD, 2005).

Owing to the important role that mathematics occupies in life, researchers have historically focused increasing attention on mathematics course-taking behaviors and performance among secondary school and college students. The potential factors influencing success or failure in mathematics are extensive and varied, and span personal, psychological, demographic, situational, and pedagogical variables. On the university level, in a study of French and Italian student samples, Corbiere, Fraccaroli, Mbekou and Perron (2006) found a significant positive correlation between academic self-concept, academic interest, and academic achievement in mathematics.

Gutpa, Harris, Carrier and Caron (2006) found that older male students, those who missed fewer classes, and those who expressed more positive attitudes towards mathematics were more likely to score higher in first year mathematics courses.

Seidman (2005) found that there is a correlation between a student's background (both academic and social) and the institutional characteristics (academic and social), indicating that a similarity between them promotes academic success.

Ethnicity and Gender

One effort that has been successful in promoting high levels of undergraduate mathematics performance among African American students is the Mathematics Workshop Program (MWP) at the University of California, Berkeley (Fullilove & Treisman, 1990). HBCUs have several programs and practices that have helped to increase the number of students graduating with STEM degrees (Southern Education Foundation, 2005). According to a 2005 report authorized by the Southern Education Foundation, these programs provide high levels of mentoring, counseling, and guidance throughout undergraduate studies; rigorous interactive instruction; adequate financial aid; and hospitable campus climates in addition to caring learning environments.

Jett (2013) examined the educational experiences of African American male students at historically black colleges and universities (HBCUs), because researchers have neglected to hone in adequately on the mathematics experiences of African American male students at these institutions. This qualitative study highlighted the importance of HBCUs in producing successful African American male mathematics majors. Findings provided evidence that HBCUs provide supportive structures, mechanisms, and people, especially African American male mathematics professors, who contribute to the mathematical success of African American male mathematics majors. From the narratives of the three participants, it was recommended that researchers continue to tap into the academic networks and intellectual communities established at HBCUs. Another recommendation was that researchers examine the role and impact of

HBCUs in producing African American mathematicians and mathematics educators. This examination should also be inclusive of those individuals seeking to enter STEM fields. Because HBCUs abound in producing African American college graduates, the successful established (mathematics) practices at these institutions should be researched and brought to the forefront if institutions are serious about sustaining our African American mathematical communities, ensuring that African Americans continue to enter the mathematics pipeline, and producing more mathematics and science teachers of color (Kimbrough & Harper 2006).

Further, researchers should (continue to) initiate conversations with those STEM scholars at HBCUs who have a legacy of producing African American mathematicians, especially African American male mathematicians. Also, researchers investigating these complex issues regarding the participation of African American men in mathematics should employ theoretical perspectives such as critical race theory to bring issues of race and/or racism to the forefront given that race seems to be a recurring impediment to those seeking to pursue STEM degrees and careers. More specifically, the experiences of African American male mathematics HBCU alumni should be examined as they enter graduate programs and industry work to ascertain the ways in which HBCUs mobilized them for such work.

On the positive side, a study of 28,000 traditional-age college freshmen in Ohio found that African American students who took one or more remedial classes were more likely to persist in college than students with similar backgrounds who were not in remediation (Bettinger & Long, 2009). A study of a large number of community college students found no difference in long-term academic outcomes between students who

“remediated successfully” in mathematics - that is, passed a college level mathematics class after first taking a remedial class - versus students who passed a college-level math class without taking the remedial class first (Bahr, 2008). However, in this study, three out of four remedial math students did not remediate successfully, and the outcomes for those students were disastrous, with 81.5% neither completing a credential nor transferring to a four year school (Bahr, 2008).

D'Ambrosio (1985) stated that "mathematics has been used as a barrier to social access, reinforcing the power structure which prevails in the societies. No other subject in school serves so well this purpose of reinforcement of power structure as does mathematics" (p. 363). D'Ambrosio's analysis targeted lack of equity in mathematics education. Bannister et al. (2007) assert that "the racialization of mathematics education is intertwined with issues of power and authority, making it difficult, if not impossible, to examine issues of race without also considering the impact of power dynamics on mathematics teaching and learning" (p. 405 - 406). Martin (2006b) has suggested similar beliefs that research about African American learners of mathematics would be ill-informed and irresponsible if it ignored the power structures within mathematics education that may serve to limit the success of African American students. For African American students in mathematics, race has consistently impacted educational experiences. Traditional reports often fail to acknowledge that educational spaces too readily become breeding grounds for the systematic marginalization of Black students

Researchers have substantiated the need to understand the racialized mathematical experiences of Black students, including the experiences of those who have maintained high achievement in spite of encountering frequent marginalization (McGee, 2013b, 2013c, 2014). Implying that failure is a predictable outcome for Black students studying

mathematics leaves little room to explore Black students' success, agency, and resilience in the field. The lack of research on African Americans' success in mathematics leads to the mistaken conclusion - and widespread stereotype - that above-average achievement in this area is somehow nonexistent among Black students. Inattention to intragroup differences, including the fact that some mathematically talented Black students endure racial bias within and beyond the classroom, fuels the perception of racial disparities in mathematics achievement (Martin, 2012; McGee, 2013a).

Perna et al. (2008) conducted a case study regarding the preparation of African American women for STEM careers at Spelman College. The participants in their study generally agreed that Spelman College provided them with the support that they needed to be successful in STEM professions such as peer support, faculty encouragement and involvement, academic support, and undergraduate research opportunities. It is also interesting to note that curricula materials were organized to ensure that these women could visualize themselves as competent STEM thinkers and that research opportunities were designed to yield financial support to those conducting STEM-related research.

Walker and Plata (2000) examined race, age, and gender differences in the mathematics performance of college students in three developmental courses. Participants were 500 students, of whom 333 were Anglo, 167 were African American, 205 were male, and 295 were female. Students who did not show proof of competency in algebra upon admission to the university were placed in math courses based on ACT/SAT of TAKS scores. Two age groups were developed: the first group (80%) consisted of students between the ages of 18 and 26 (younger group), and the second group (20%) consisted of students over 26 years of age (older group). Grades were grouped into pass-fail categories for each developmental math course to determine overall pass-fail

frequencies. Letter grades for Anglo and African American students were analyzed to determine grade distribution across developmental math courses.

Results revealed that a relationship existed between enrollment patterns in math courses and ethnicity and age but not gender. In addition, a relationship existed between pass-fail frequencies and age, ethnicity, and gender; and a relationship existed between grades and ethnicity in two of the three developmental courses. Specifically, a relationship was found between course enrollment and age across ethnic groups. There were fewer than the expected number of younger Anglo students enrolled in fundamental math, but more than the expected number enrolled in intermediate algebra. More than the expected number of younger African American students were enrolled in elementary algebra and fewer than the expected number in intermediate algebra. For the older group, there were more than the expected number of older Anglo and African American students in fundamental math and fewer than the expected number of older Anglo and African American students in elementary algebra. Finally, there was a significant relationship between ethnicity and pass-fail frequencies. More than the expected number of Anglo and African American students passed and fewer than the expected number failed fundamental math. Fewer than the expected number of Anglo students passed, and more than the expected number of African Americans failed elementary algebra. There was more than the expected number of Anglo students who failed intermediate algebra.

Increasing degree completion rates for Latino students is critical for the United States to meet its future workforce and societal needs (Santiago, 2011). Crisp, Reyes, and Doran (2017) conducted a study of Latina/o students' remedial math needs and outcomes. Data were taken from a national sample of Latina/o students. The sample included the 640 Latina/o students attending 290 institutions in the 2009 Beginning

Postsecondary Students Longitudinal Study. Additional description of the data set included students (a) enrolled in one or more remedial math courses, (b) had complete institutional data, and (c) were less than 24 years of age.

McGee's (2015) article illustrated the utility and explanatory power of the framework in narrating and problematizing stories of Black college students in the fields of mathematics and engineering who have excelled academically through racially tumultuous terrain. Considerable progress has been made in understanding the mathematical identity of African American students, adding racial and cultural constructs for analyzing students' educational and mathematical learning experiences. Mathematics education research has benefited from the use of culturally and racially relevant definitions of mathematical identity in unpacking the complexities of African American students' participation in mathematics. Martin (2000, 2006, 2009, 2013) has published extensively on issues related to African American learners (children, adolescents, college students) and parents, exploring the role of what it means to be Black and a doer of mathematics and the intersectionality of mathematics and racial identities. His work has taken into account the historical legacy of racism and the continuing segregation and discrimination of African Americans and how these experiences contribute to a collective identity of what it means to be Black. Martin (2006; Martin & McGee, 2009) and others (Gutiérrez, 2008; Stinson, 2013) have advanced the assertion that mathematics learning and participation can be conceptualized as racialized forms of experience. This perspective suggests that the meanings for race are very salient in structuring mathematical experiences and opportunities and just as relevant in shaping common-sense beliefs and official knowledge about who is competent (or not) in mathematics. Although negative outcomes in mathematics education among Black students are

sometimes incorrectly attributed to race (as biology), Martin's work discussed above demonstrates the racialized nature of students' mathematical experiences that most profoundly influences these outcomes.

The study by Crisp et al. (2017) is significant because students enroll in remedial math courses more than any other subject area (Bahr, 2007). There is a need to understand the obstacles faced by students who require remediation in mathematics (Bahr, 2008b). Bahr (2013) notes that a majority of community college students require some type of remedial assistance with mathematics, indicating that many students arrive at college underprepared for college-level math, a "gatekeeper" course that may keep students from progressing through their course sequence into more advanced courses (Roksa, Jenkins, Jaggars, Zeidenberg, & Cho, 2009). Recommendations from the research revealed that among Latina/o students, successful remediation is influenced by a combination of socio-demographic and precollege variables, degree expectations, academic experiences and pull factors, and institutional-level characteristics. In particular, students' gender, age, Latina/o ethnic subgroup, first-generation status, high school GPA, highest math course taken in high school, and college-level credit was earned or not earned prior to enrolling in college were hypothesized to be related to Latina/o students' odds of successfully remediating in math. Additional quantitative work is therefore recommended to be able to better predict success for this growing and arguably overlooked and undervalued group of students. Results of the present study would suggest there is a crucial need to study Latina/o students who have the highest remedial need, as it remains unclear why students who place in the lowest levels of remediation do not successfully complete college-level courses (Bahr, 2010).

Women are also stereotyped as bad at math; men, in contrast, are assumed to be good at math (Nosek et al., 2002). A number of studies on young women have demonstrated that women may experience stereotype threat because of the bad-at-math stereotype. Stereotype threat is defined as the social-psychological threat arising from a situation or activity for which a negative stereotype about one's group applies. Specifically, it is the anxiety individuals from stigmatized groups have that their behavior might confirm the negative stereotypes imposed upon their group (e.g., women are bad at math; Steele, 1997; Steele & Aronson, 1995).

Women in the aggregate are less likely than men to choose STEM majors. This masks the fact that women in certain STEM fields (e.g., biology, mathematics) have reached parity, while others (e.g., engineering, computer science) have not (Riegle-Crumb, King, Grodsky, & Muller, 2012; Riegle-Crumb, Kyte, & Morton, 2018; Salzman & Benderly, 2019). The gender differences in major have been attributed to perceptions of gender discrimination and the "chilly climate" for women and some minorities in certain fields (Ganley, George, Cimpian, & Makowski, 2018). Although large differences are observed in initial choice of major, research finds that subsequent attrition from STEM fields in college does not differ by gender (King, 2016).

Good et al. (2008) examined stereotype threat for women and men in advanced college math courses. They found that performance on a difficult math test was higher for women than men when students were told there was no gender bias in the test, but was comparable when the gender bias of the test was not negated. Further, an assessment of course grades at the end of the semester showed that female and male students did not differ in the grades they received. However, women who were told that there was no

gender bias in the test performed better than would have been predicted from their final grades.

Gender stereotypes associated with gender and math also influence women's attitudes about math and their self-confidence to perform well in math. For example, Nosek et al. (2002) found that stronger math equal male stereotypes related to more negative math attitudes for women but more positive attitudes for men. In addition, women who identified with being female but associated math with males had particular difficulty associating math with themselves. Similarly, Lane et al. (2012) found that holding math equal male stereotypes predicted women's plans to pursue science careers such that having a stronger association between males and math related to fewer plans to pursue such careers. This was especially the case for women who identified strongly with being female. Moreover, despite equal ability and comparable past performance on math tests, women report lower self-efficacy in math and science than men (Else-Quest et al., 2010; Sáinz & Eccles, 2012).

Tutoring

Peer tutoring programs represent a key component of the learning support structure at universities across the United States. One common type of peer tutoring program engages advanced undergraduate students who have successfully completed a course to lead a small group of currently enrolled students in problem solving sessions. Another widely used intervention to improve undergraduate student success in mathematics is Learning Support in Mathematics (LSM), an umbrella-term for any extracurricular, optional support service provided as a supplement to classroom based, credit-bearing coursework. There are three types of LSM, center-based support, supplemental instruction, and peer-assisted learning.

Center-based Tutoring. Studies in the UK (Pell & Croft 2008; Symonds et al., 2008) and Ireland (Ní Fhloinn et al., 2014) have shown that while, center-based support has expanded and is now readily available to students at many universities, the resource is underutilized and students who could most benefit from the extra help do not access it. Pell and Croft (2008) compared 664 first-year engineering students' attendance records at the Loughborough University mathematics support center with their final course grades, and found that students with the highest grades used the center more than students who struggled in the course. Thirty-five percent of students who received an A (the highest mark) in their math course used the center more than once, compared with 22% of students who received a D grade and were at risk of failing the course. Of students who failed the course, only 15% used the math center. The authors suggest that "this would indicate that fail grade students as well as having ability problems also have attitudinal problems" (Pell & Croft, 2008, p. 171).

At Dublin City University, first-year students who were "at risk" of failing their math course were identified by use of a diagnostic test. The "at risk" students were encouraged to use the mathematics support center "as early and frequently as possible" (Dowling & Nolan, 2006, p. 52). In the first year of the program, 80 students were identified as "at risk." Forty-one of these students visited the mathematics support center at least once. The pass rate for students who visited the center was 53%, versus just 25% for the students who did not take advantage of the mathematics support center. The following year (2005-2006), scoring of the diagnostic test was altered to identify more students as "at risk." In that year, 95 of the 161 "at risk" students attended math support sessions at the center. Sixty percent of the students who used the service passed their course, compared to 49% who did not attend.

Gillard et al. (2011) distributed an e-mail survey to 40 universities known to offer some form of LSM, and received responses from mathematics support providers at 19 universities in the UK, one in Australia, and one in Ireland. Survey questions were open-ended. The first questions on the survey were, "Please describe how you deliver mathematics support. What are the main problems you encounter when providing such support?" (p.46). One of the problems frequently reported was that students who could most benefit from the service do not seek it out. The study's authors assert that "the majority of students using Mathematics Support Centers are the students who are enthusiastic, rather than the students who are considered 'at risk" (p.46).

Supplemental Instruction Tutoring. One way to circumvent students' reluctance to seek help is to bring the help to them. One specific type of peer-led academic assistance is Supplemental Instruction (SI). The key structure of SI is based on a collaboration between SI leaders, course instructors, and a certified SI supervisor. SI leaders are students who have successfully completed the targeted course, ideally from the same instructor. The SI leader acts as a model student, attending all class meetings, taking notes, and doing all of the course assignments. The SI leader offers supplemental study sessions outside of class time, where he or she facilitates discussion and group problem solving.

In a comparison between center – based tutoring support and a SI program, Hodges and White (2001) found that SI made a greater difference in GPA than tutoring did. One hundred and three at-risk first-year undergraduates were given access to both SI and tutoring in math and history courses. Attendance was low for both SI and tutoring. Of the 103 students in the study, only 68 attended at least one tutoring session. Of the students who used tutoring, over half (57%) went to fewer than 6 sessions. SI use was

also low, with 56% of students attending no more than three sessions. Even with the low participation rates for both interventions, GPA for students who participated in SI was significantly higher than for students who did not attend. There was no significant difference between the students who attended or did not attend tutoring.

The findings of Rheinheimer, Grace-Odeleye, Francois, and Kusorgbor (2010) contradict Hodges and White (2001) in that tutoring was found to be a highly significant predictor of student success. They followed three cohorts of incoming at risk freshmen at a public university in Pennsylvania, tracking their use of a variety of tutoring services, including one-on-one and small group sessions as well as use of SI.

Of the 129 students in the sample, only 25 graduated. The other 104 withdrew from college. Use of tutoring was shown to be a highly significant factor in determining whether a student would persist to graduation. Students who were tutored were 13.5 times more likely to graduate than students who were not tutored. In fact, only one of the 25 students who graduated did not use tutoring at all.

Peer Assisted Tutoring. Many colleges and universities offer programs that are similar to SI, called PAL (Peer-Assisted Learning). Topping and Ehly (2001) define PAL as "a generic term for a group of strategies that involve the active and interactive mediation of learning through other learners who are not professional teachers" (p. 113). As is the case with SI, most PAL studies measure successful outcomes in terms of grades (Dawson et al., 2014; Drane, Micari, & Light, 2014) or increased retention (Grillo & Leist, 2013).

Parkinson (2009) ran a controlled study of PAL programs in math and chemistry for first year undergraduates in the biotechnology program at Dublin City University in Ireland. Students who participated in PAL had significant and substantial improvements

in performance (13% or more) compared to the control group. The results from the pilot were so convincing that the university now offers PAL programs for all first-year courses in the biotechnology major. An observational study of a PAL program in two undergraduate math courses (College Algebra and Probability and Precalculus I) at the University of Minnesota found that participating in just 3 PAL sessions was enough to predict a significant increase in the probability of successful completion of the course. Further, students who attended all PAL sessions had a ten-fold chance of success compared to students who did not participate (Cheng & Walters, 2009).

Xu et al. (2001) conducted a study examining the effects of peer-tutoring on students' mathematics performance in a college algebra course. The study was composed of two groups of students in college algebra courses where a treatment group consisted of students using tutoring services, and a comparison group consisted of students not using the tutoring services. The results of the study found no statistically significant difference between the groups' final exam grades. However, there was a statistically significant difference within the treatment group specifically, at-risk low performing students' grades were higher when they used the tutoring services with higher frequency. The researchers recommended that developmental courses in mathematics be continued. However, these courses need to be modified in order to address the needs of females and African American students.

Marx et al. (2016) conducted a study exploring peer-tutoring relationships and how they influenced students' self-reliance and their academic performance. Marx et al. examined 333 tutor and tutee pairs at a learning assistance center in the spring of 2015. Findings from their study showed that an increase in frequency of tutoring sessions with their peers, and the quality of the interactions between the tutor and the tutee, were

probably associated with an increase of independent study habits for the tutee, and higher college algebra academic outcomes for the treatment group as measured by end-of semester grades. Additional studies conducted on peer-tutoring have found evidence of positive effects on student mathematics performance.

Faculty mentors and peer mentorship have proven to maintain, support, and propel several African American students at HBCUs, especially in the realm of mathematics. Given that mathematics is constructed as a discipline reserved for white men (Stinson 2010), HBCUs help to debunk this myth and provide positive portraits of mathematically competent students, instructors, and scholars. As such, HBCUs are vehicles of hope regarding equity and access for African American students in the realm of higher education in general (Brown & Davis, 2001) and mathematics in particular.

Type of Instructional Method

While the attractiveness of online courses can be understood from a student perspective, institutional factors are also driving growth in online course offerings. Nguyen (2015), through careful analysis of a variety of studies, concludes that the current state of research into the efficacy of online education reveals that student achievement is modestly better in online courses, though the effect size of this difference is greatest in courses that blend online and face-to-face components. Finding similar results, Means et al. (2009) also concluded that online courses had greater effect sizes than face-to-face instruction when the online instruction is facilitated by an engaged instructor rather than the instruction being completely asynchronous. Because of conclusions such as these, it is time for researchers to move beyond simple adherence to the No Significant Difference mantra and reconsider arguments for online learning which are not built upon that phenomenon alone (Nguyen, 2015).

Lack's (2013) meta-analysis of current research into online education at the postsecondary level did not conclude, as the literature cited in the previous paragraph, that online learning produced better student outcomes; however, this work did conclude that there was little if any evidence to show that online learning was less effective than face-to-face instruction. Though this is an argument by contradiction, a lack of evidence suggesting that online education is less effective than traditional delivery methods is an argument against opponents of online educational offerings.

Studies of the relative effectiveness of online instruction continue to show either no statistical difference in student learning outcomes or advantages toward the utilization of online learning platforms, but these studies are narrowly focused. Studies revealing such favorable conclusions exist for online learning in environments ranging geographically across the nation and educationally from community college to graduate school. However, these studies are already factored into meta-analysis work revealing only little to any difference in student achievement (Bendickson, 2004; Herman & Banister, 2007; Lyke & Frank, 2012).

Ashby et al. (2011) conducted an analysis of the impact of delivery methodology, comparing online, blended, and face-to-face methods in developmental mathematics courses at a community college, and the initial results contradicted other evidence. They found that students receiving face-to-face instruction achieved at higher levels than online students. This study measured student success both by the percentage of passing grades and by the student's scores on a standardized final exam. However, these results reversed, with online students outperforming face-to-face students when the authors trimmed the sample to include only students who finished the entire course, since the

attrition rate was significantly higher among the students in online courses in this study (Ashby et al., 2011).

This pattern of online students having a high success rate when compared to students in face-to-face sections of a course is not consistent, and there is even evidence that lower performing students performed better in the face-to-face sections (Peterson & Bond, 2004). Most of these studies were focused only on well-prepared students, yet the population of remedial mathematics students in a community college is considerably different (Xu & Jaggars, 2011).

One study at Virginia Tech reported that students in its technical developmental mathematics program, which was taught using online instruction, scored a half letter grade better than other students; but this study was contradicted by the study of a similar course at community colleges in Florida (Bendickson, 2004; Cafarella, 2014; Holton, Muller, Oikkonen, Valenzuela, & Zizhao, 2009). Trenholm (2006) found that community college students in a computer-mediated mathematics course using the software MyMathLab had higher grades on a proctored final exam than did students in courses with other delivery methodology. However, these results differ from Ashby et al. (2011) who only found such an advantage using a trimmed sample which controlled for course completion. The literature is divided about the impact of online delivery on student achievement.

Whereas, direct student achievement is an important consideration, it is critical, when considering retention and persistence, to also consider the impact on student satisfaction when taking a mathematics course online. One study, which considered the impact on both achievement and satisfaction when using an online delivery methodology in an introductory statistics class, found there was no difference in student achievement;

but student satisfaction with the course was found to be significantly lower as compared to students who took the course in a face-to-face format (Summers et al., 2005).

In order to be successful in online courses, including online mathematics courses, students need to be self-regulated learners; however, many remedial mathematics students are not self-regulated learners and do not have the necessary educational background to succeed in an online learning environment (Ashby et al., 2011; Driscoll et al., 2012). Rather than approaching online learning with an appropriate expectation of the increased self-regulatory responsibilities imposed on the student, students often report believing that online courses will be considerably easier than courses delivered in a more traditional manner (Bambara et al., 2009).

In his study of best practices in remedial mathematics, Cafarella (2014) found that two of the significant reasons for a lack of student success in developmental mathematics were student attendance and work habits. This is consistent with other studies, which found that faculty often report student immaturity and poor study skills as substantial contributing factors in the lack of student success for developmental mathematics students (Zientek et al., 2014). Students in developmental mathematics courses are hampered in their efforts to understand more complex mathematical concepts by a poor foundation in arithmetic, but these students are also most likely to attempt to learn mathematics by memorizing abstract formulas and procedures rather than developing an understanding of the material and drawing deep connections between concepts (Cafarella, 2014).

There are also unique communication challenges in online mathematics courses, which fact inherently increases the difficulties for developmental students (Ashby et al., 2011). Online education is not as conducive to passive learning styles as face-to-face

instruction is, and students in developmental mathematics courses are often passive mathematics learners (Ashby et al., 2011; Driscoll et al., 2012). Beyond learning styles, it is difficult for online mathematics students to ask technical or procedural questions because of the unique set of mathematical symbols that are often necessary (Driscoll et al., 2012).

A final substantial issue for educational leaders to consider in regards to online developmental mathematics instruction is the importance of developing relationships between students and faculty. Previous struggles in mathematics can result in mathematical anxiety or a lack of mathematical self-efficacy (Summers et al., 2005). Because of this generally lower mathematical self-efficacy, it is critical for developmental mathematics students to receive clear directions, timely feedback, and personal encouragement from instructors in order to reduce a student's anxiety in the course (Herman & Banister, 2007; Summers et al., 2005). Even among otherwise engaged students, mathematical motivation appears to be a separate attribute from academic motivation, so instructors should be particularly diligent in communicating with and encouraging remedial mathematics students (Guy et al., 2015).

A qualified study by Salvo, Shelton, and Welch (2019) identified factors that promoted online course completion among African American male undergraduate students. The researchers interviewed 10 males who successfully completed online courses and identified significant themes. This investigation examined challenges and obstacles encountered by African American male undergraduate students who completed online courses. Participants revealed challenges such as lack of professor interaction, lack of immediate feedback, insufficient number of examples, lack of notifications, lack of teacher-directed instruction, and lack of teacher mediated assessments. After conducting

a qualitative phenomenological study examining economic, academic, and technologic influences, as well as challenges, encountered by 10 African American male undergraduate students who successfully completed online courses, the following factors were found: financial assistance, prior academic achievement, previous training in information technology during high school, continuous academic enrollment, online courses on topics perceived as uncomplicated and less demanding or on topics that were familiar to the students due to sufficient prior knowledge, use of handheld digital devices, and a non-prejudicial learning environment.

Findings of this study suggest several areas that merit further investigation. This study was limited to a mid-sized university in the South where African Americans represented less than 20% of the population. Investigations conducted in larger universities, more racially diverse universities, or universities in other geographic regions would add to the knowledge base of African American male undergraduate students in distance learning environments. Participants indicated that cultural neutrality of online learning environments was a factor in online course completion. While this perception was found in other studies (Collins, 2014; Romero & Usart, 2014), it is likely subjective and deserving of more rigorous investigation. Quantitative methods would be very useful in informing this area of research.

Xu and Jaggars (2013) found certain academic subject areas appear more difficult to learn in the online context, and some subjects may require intensive student-instructor interaction. Bambara et al. (2009) noted online students struggled learning unfamiliar and complex course materials, and Jaggars (2014) observed that college students preferred taking easy academic subjects online and difficult or important subjects face-to-face. Based on the results of this study and findings from other studies, supporting academic

achievement, enrollment in information technology courses, facilitating higher education enrollment immediately after high school graduation, and ample online academic support for students learning difficult subjects may promote online course completion among African American male undergraduate students.

College Readiness in Math

Mathematics instructors observed that typical freshman students were not prepared for college level mathematics (Corbishley & Truxman, 2010). Educators in high schools need to reflect on the findings of college math faculty so that high school programs can be created or modified to improve preparation for student success in college (Corbishley & Truxman, 2010). Researchers support reform initiatives that stress critical thinking throughout high school (Corbishley & Truxman, 2010). Unfortunately, the majority of time in lower level U.S. mathematics lessons is spent on routine processes and repetition rather than on problem solving (Burrill, 1998). Without problem solving, it is difficult to transition to higher forms of mathematical thinking (Corbishley &Truxaw, 2010).

Students are often deficient in basic mathematical abilities upon entrance into higher education and universities are forced to correct students' deficiencies by offering remedial mathematics courses (Gillard, Robathan, & Wilson, 2011). Institutions have noted that there is a positive influence on learners who use remedial support. Learners also sense that such support is an invaluable asset for their educational growth (Gillard, Robathan, & Wilson, 2011).

Higher education educators who work with freshman students continuously mention the decreased level of readiness of secondary school graduates and the qualitative change in the way that they think (Salkinov & Burukhin, 2010). There is a

lack of training in physics, technology, mathematics, ecology, and biology (Salkinov & Burukhin, 2010). If secondary school educators use technology wisely, the learning process in universities and colleges will decrease the amount of time for freshman students to adapt (Salkinov & Burukhin, 2009).

Cooperative Learning Support Service

Artzt and Newman (1990) described cooperative learning as small group activities aimed at completing a common goal. Johnson, Johnson, and Smith (1991) defined cooperative learning as the educational approach of small groups of students that maximized their learning by reflecting on each other's knowledge. Davidson (1990) considered cooperative learning a task for groups to discuss and possibly find a solution. In addition, students required face-to-face interaction, an environment that provides positive experiences by helping each other attain success (Davidson, 1990). Goodsell, Maher, and Tinto (1992) identified cooperative learning as a more general form of collaborative learning that was described as students working in groups, searching for a solution in order to deliver a product. According to Johnson et al. (1991), it is essential for teachers to be aware that cooperative learning requires all students in a small group to participate, and if one of the team members completed the work first, he or she has to help his or her team members to complete the work.

Representatives from The National Council of Teacher of Mathematics and the National Research Council reported the need for a change in mathematics and sciences in general and specifically in statistics (Cobb, 1992). The recommendations made in the reports were to support cooperative learning activities in the classroom instead of traditional lectures. Cooperative learning increases social interactions because students work in groups and participate with one another. According to Johnson et al. (1991),

research showed that cooperative learning activities also led to maximized students' efficiency and attitudes. Furthermore, cooperative learning is essential to developing skills for employment because there is a need for more employees to be able to work in groups (Johnson et al., 1991).

Shaughnessy (1997) conducted a study of college statistics courses using cooperative learning. The research findings reported that the utilization of "small groups" seemed to improve students' understanding of statistics concepts and support learners on overcoming misunderstandings in probability. Dietz (1993) established that by using cooperative learning to teach approaches to choosing a sample, students created their own standardized sample methods, which demonstrates higher level critical thinking. Jones (1991) used cooperative learning in different statistics sections, and the results were an improvement in students' participation, attendance, and office visits. According to Jones et al. (1991), "cooperative learning" promoted learners' motivation.

Cooperative learning activities are connected to constructivism and are a large part of the current reform in higher education, particularly in mathematics and science (Garfield, 1993). Educators need to design small group activities that transform the classroom into a community of students who dynamically work together to learn statistics (Garfield, 1993). Thus, teachers using cooperative learning provided students with opportunities to teach each other, and research has shown that ensuring this method of secondary instruction is extremely effective in increasing student learning (McKeachie, Pintrich, Yi-Guang, & Smith, 1986).

According to Johnson et al. (1991), there are two kinds of cooperative learning groups: informal and formal. To implement cooperative learning successfully, the role of the teacher changes to that of a facilitator (Garfield, 1993). In addition, the instructor

needs to make sure that students are told they will learn statistics by asking questions, answering questions, and helping each other (Garfield, 1993). It is also essential for the instructor to provide students with guidelines for being respectful to other team members (Garfield, 1993). Students need to be aware that there are several ways to solve one problem, and the different approaches to solve it generate a deeper understanding of others (Garfield, 1993).

Zakaria, Chin, and Daud (2010) conducted a quasi-experimental study to determine the effects of cooperative learning on students' performance and attitudes in mathematics by conducting a t-test. The experimental group was composed of 44 students and a control group of 38 students (Zakaria et al., 2010). Findings showed that cooperative learning improved students' performance and attitudes in mathematics (Zakaria et al., 2010). Furthermore, cooperative learning was recommended for mathematics teachers to incorporate in their classroom (Zakaria et al., 2010).

Majors STEM and Non-STEM

Douglas and Salzman (2019) advanced the understanding of math course taking by developing course-taking metrics for a nationally representative cohort of bachelor's graduates. Using NCES transcript data to construct consistent measures of mathematics and quantitative course taking, their analysis finds large variability both within and between STEM/non-STEM majors and a large population of non-STEM graduates earning mathematics credits comparable to their peers in STEM fields. The researchers found that mathematics course taking differs substantially from course taking in other subjects. They also found that often-observed gender differences are a function of major, not gender, with females in the most mathematics-intensive programs earning as many or more mathematics credits than their male peers.

Geddes (2015) used the National Longitudinal Survey of Freshmen (NLSF) to examine the role of peer effects in determining students' course taking and major choices, finding that women were less likely than men to take a math course in their freshman year and that female students at schools with a larger proportion of women take significantly fewer math courses overall. Conclusions often drawn from these studies are that there are gender disparities in mathematics course taking and/or achievement.

Data from Post et al. (2010) indicate that nearly two-thirds of the students in their sample took two or fewer math courses. Geddes's (2015) data on college freshmen show that only half of these students took a college math course in their first year, with an average of one course among those who took any math courses. While these studies provide some insight into questions of postsecondary mathematics course taking, they are far from exhaustive. Moreover, these studies do not explicitly state which types of courses count in their definition of mathematics, potentially biasing course-taking estimates by including only certain types of math courses.

Summary

Mathematics is an important and hotly contested aspect of U.S. postsecondary education. Its importance for academics and careers and the extent and impact of math achievement disparities are all subjects of longstanding debate. Yet there is surprisingly little research into how much and what types of mathematics courses are taken by U.S. undergraduates and the extent of math achievement differentials among students. While some students require reading and writing remediation, more students require mathematics remediation.

The culture of learning for college students is changing; it is becoming an informal practice because students are learning from one another. Peer tutoring creates a

similar informal setting during a session. Tutees meet with a peer for the purpose of learning without the intimidation of a teacher and the student can take as much time as needed.

More recent studies into the efficacy of online instruction continue to suggest that online education can be at least as effective as traditional alternatives, but any real difference is modest. There is a variety of factors that have been shown to be integral for student success in online education math courses, and a number of these factors are related to the quality of the instructor. Student success is greater if the instructor is able to provide quality explanations and develop clearly defined routines of study for students without direct contact.

CHAPTER 3

METHODOLOGY/RESEARCH DESIGN

The purpose of this study was to examine the predictability of the relationship between selected personal, academic, and service-related factors and the perceived academic success in mathematics among college students. This chapter will consist of twelve (12) sections: 1) type of research design; 2) population and research setting; 3) sampling procedure; 4) instrumentation; 5) validity of the instrument; 6) reliability of the instrument; 7) data collection procedures; 8) pilot study; 9) independent and dependent variables; 10) Null hypotheses; 11) statistical analysis; and 12) evaluation of statistical assumptions.

Design of the Study

A predictive Correlational research design (See Figure 1) was employed in this study. This type of research methodology provides the researcher with the opportunity to assess a set of hypothesized relationships between selected variables for the purposes of determining their predictive association. Additionally, according to Mertler and Vannatta (2007) the predictive correlational research design has two major purposes. First, this type of design allows the researcher to develop a statistical model that can be used to predict values on a criterion variable for all members of a population. Secondly, this type of research design can provide an explanation for establishing causal relationship among variables. Furthermore, in the current study, the predictive correlational research paradigm provides the researcher with direct path linkages in evaluating the predictable

relationship between selected personal, academic and service-related factors and the perceived mathematics success among college students.

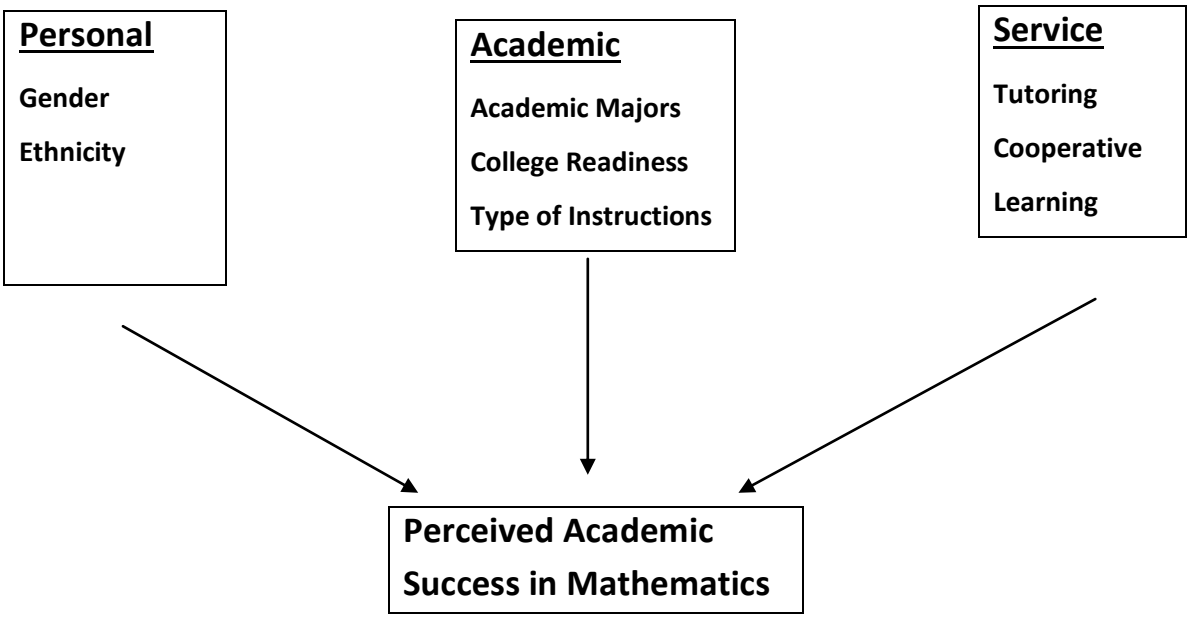

Figure I: Predictive Correlational Model

Population and Research Setting

The population of this study consisted of lower level undergraduate students enrolled at two (2) institutions of Higher Learning located in the southern region of the United States. One of the institutions was a four-year university and the other institution was part of a large urban community college system.

Institution A, a four-year public institution in Houston Texas, had a student clientele of over 20,000. Over 50 percent of the students were white, 22.6 percent were Hispanic American, 17.4 percent were African American, and almost 6 percent were "other" students. This institution offers more than 80 undergraduate degree programs, along with master's and doctoral degrees. Further, 21 percent of the students resided on

campus and 79 percent lived off campus. The institution encompassed over 370 acres in a rural area.

Moreover, Institution B was one of seven two-year public colleges under the auspices of a large urban community college systems. Almost 26 percent of the community college system student population is enrolled at this institution. The student clientele of this institution is over 22,000 with a high racial diversity.

Sampling Procedures

The non-probability convenience sampling procedures were employed in this study. This type of sampling technique is employed when participants are selected based on availability or convenience. In addition, this non-probability sampling procedure is used quite often with college students because many researchers in education conduct their research at the university or college in which they are employed (Huck, 2004).

Additionally, convenience sampling has several drawbacks. First, it does not ensure that a sample will be representative of the target population; and, secondly, in this procedure, convenient individuals have a better chance of being selected than those who are less convenient (Huck, 2004). Even though, the convenience sampling technique has its' limitations, the researcher who utilizes this procedure has the ability to generate his or her sample from the accessible population.

Instrumentation

A modified version of the Mathematics Attitudes and Perceptions Map Survey was used in this study. This investigative instrument was employed in the study since it assesses how college students in mathematics perceived their success in this academic area. The modified MAP Survey was divided into four major sections. Section one entitled personal characteristics dealt with three items. Items two and three in this section

were coded one to five (1 to5). In addition, item one was coded one to two (1 to 2), respectively. Item 7 was coded one to three (1 to 3).

Moreover, section two of the investigative survey was entitled academic characteristics and contained four items. Item 4, 5, and 6 were coded one to two (1 to 2) respectively. Item 7 was coded one to three (1 to 3).

Additionally, section three was entitled service characteristics, and consisted of two items. Both items 8 and 9 were coded one to two (1 to 2). Inasmuch as section one, two, and three were composed of the personal, academic, and service characteristics of the participants, the scoring of one to five does not represent a perceptional sequence, only categories.

Finally, section four contains twenty items in a Likert format. This section was entitled Perceptions Toward Mathematics Success. Items in this section required that the participants check one of five structured expressions: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. Each of the above close ended expressions were assigned the following score for analysis purposes: Strongly Agree, (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). The items in section were summated and a total score ranging from 20 to 100 was computed for each student participant. The higher the score in this area, the more favorable the perception was toward mathematics success.

Validity of the Instrument

Content validity was established on the modified version of the Mathematics Attitude and Perception Survey. A panel of experts knowledgeable of the factors associated with being successful in mathematics was selected by the researcher. Once

identified, the researcher requested their participation in the study and provide a copy of the survey to each member of the validation panel. The validation team was asked to evaluate the content of each item pertaining to the perception regarding mathematics success.

Moreover, the panel of experts was asked to judge both the instrument by responding to each item and the instrument by employing the validation value of one to three, a value of three meaning the item is valid, two meaning the item is not clear, and one meaning the item is not valid. Once the panel of experts agreed that the instrument was valid, the researcher then field tested the survey.

Reliability of the Instrument

To establish reliability of the Modified Version of the Mathematics Attitudes and Perception Survey, the split-half procedure was employed. This type of reliability procedure assesses the internal consistency of the instrument, which determines how all items on the instrument are related to other items on the instrument.

In order to establish the split half reliability procedure on the investigative survey, the researcher correlated the even numbered items with the odd numbered items. This process generated reliability for half of the survey. Once this was done, the Spearman Brown formula was applied to the split half procedure to compute reliability for the total survey. Brunie and Kintz (2002) opined that a computed reliability coefficient of .70 or above on an instrument is appropriate grounds to indicate that the MAP survey is reliable.

Data Collection Procedures

In the Spring Semester of 2020, the researcher emailed a letter to the Chairperson of the Mathematics department at each of the target institutions asking permission to use the appropriate mathematics classes to conduct the study. The request for participation

was solicited by the researcher after approval by the institutions' Human Subject Committees.

Moreover, the letter explained the purpose and logistics of conducting the study. An informal written consent form was provided to each student at the beginning of the study. Participation in this study was voluntary and all personal information was anonymous. There was no risk associated with the students participating in the study.

Once the aforementioned process was completed, the researcher administered the survey to the students within each mathematics class selected to participate in the study. The participants were asked to respond honestly to all the items on the survey to eliminate non-responses. All completed surveys were coded and entered into a statistical software package by the researcher. For the purpose, the statistical package for the social sciences (SPSS) was used.

Field Study

In early spring of 2020, a pilot study was conducted to examine the appropriateness and clarity of the items as well as to assess an estimate of reliability for the Mathematics Attitudes and Perceptions Survey. Twenty college students enrolled in mathematics classes at a similar institution of higher learning were selected to participate in the field study.

Furthermore, the pilot-tested survey was examined for suggestions and criticisms. At this time, the necessary revisions were incorporated into the investigative instrument.

Independent and Dependent Variables

The variables employed in this study were selected by the researcher after an exhaustive examination of the related literature. For the present study, there were three sets of independent (predictor) variables. The first set of independent variables was the

personal characteristics associated with the student participants. The second set of independent variables pertained to the academic characteristics of the participants. The final set of independent variables entertained social service characteristics identified with the student participants.

Further, the above set of independent (predictor) variables were assumed to have some predictive validity related to the dependent (criterion) variable which is the perceived academic success in mathematics of college students.

Null Hypotheses

The following null hypotheses were tested in this study:

H_1: There is no statistically significant relationship between personal related factors (gender and ethnicity) and the perceived academic success in mathematics among college students.

H_2: There is no statistically significant relationship between academic related factors (academic major, college readiness, and type of instructional method) and the perceived academic success in mathematics among college students.

H_3: There is no statistically significant relationship between service related factors (tutoring and cooperative learning) and the perceived academic success in mathematics among college students.

Statistical Analysis

Since the present study attempted to examine the predictable relationship among variables, the researcher employed two correlational statistical procedures: multiple correlational analysis and the simultaneous (standard) multiple regression analysis. According to Tabachnick and Fidell (2007), the multiple correlation procedure

is used to assess complex interrelationships between independent and dependent variables.

Once the multiple correlation procedure were applied and significant relationships were found between the independent and dependent variables, the principles of the simultaneous multiple regression technique were employed by the researcher. The simultaneous (standard) multiple regression procedure is a statistical procedure whereby all the independent variables are placed into the regression model at once, each one being processed as if it had entered the regression equation after all other variables had been processed. Finally, this procedure assessed each independent variable in terms of what it adds to the overall prediction of the dependent variable that will be different from the predictability afforded by all the other independent variables (Tabachnick & Fidell, 2007).

Evaluation of Multiple Regression Assumption

According to Tabachnick and Fidell (2007), there are two sets of assumptions associated with the multiple regression procedures. One set of assumptions addresses the raw scale variables and the other set deals with the residuals (errors). The three assumptions pertaining to the raw scaled variables are:

- The independent variables are fixed;
- The independent variables are measured with errors;
- The relationship between the independent and dependent variables is linear.

Further, the five assumptions associated with the residuals are:

- The errors are not correlated with the independent variables;

- The means of the residuals for each observation on the dependent variables over many replications is zero;
- Errors associated with any single observation on the dependent variables are independent of errors associated with any observation on the dependent variables;
- The variance of the residual across all values of the independent variables is constant; and
- The errors are normally distributed.

CHAPTER 4

ANALYSIS OF THE DATA

The purpose of this study was to examine the relationship and predictive value of selected personal, academic, and service-related factors for the perceived academic success in mathematics among college students. Specifically, this study was concerned with the predictive value of the variables gender, ethnicity, academic major, academic readiness, type of instructional method, tutoring, and cooperative learning for the perceived academic success in math among college students.

This empirical study provided answers to the following questions:

1. Do personal related factors (gender and ethnicity) have any predictive validity with regards to perceived academic success in mathematics among college students?
2. Do academic related factors (academic major, college readiness, and type of instructional method) have any predictive validity with regards to perceived academic success in mathematics among college students?
3. Do service-related factors (tutoring and cooperative learning) have any predictive validity with regards to perceived academic success in mathematics among college students?

A convenience sample of 122 college students attending two institutions of higher learning were selected to participate in the investigation. A modified version of the Mathematics Attitudes and Perceptions Survey was used to collect the data. The analysis of data section of this study involved four major sections.

Section one dealt with the demographic characteristics of the college students in the study. Section two presented the mean and standard deviation results concerning the independent and dependent variables employed in the study.

Furthermore, section three addressed the correlational results with regard to the independent and dependent variables. The final sections analyzed the three null hypotheses formulated for the study. The Standard Multiple Regression Technique, and the Multiple Correlation procedure Pearson Product Moment Correlation along with the Point Biserial and Biserial techniques, were utilized to assess the data. All of the hypotheses were tested at the .05 level of significance or better.

Demographic Characteristics of Participants in the Study

There were one hundred twenty-two (122) college students who participated in this study. The college students were described demographically by their gender, ethnicity, annual income, major areas of study and effective teaching methods.

Gender

There were 52 or 42.6 percent of the college students who identified themselves as males. By contrast, there were 70 or 57.4 percent who indicated that they were females. See Table 1 for these results.

Table 1

Frequency Distribution of Participants by Gender

Variable	Number	Percent
Gender		
Male	52	42.6
Female	70	57.4
Total	122	100.0

Ethnicity

For the present study, the variable ethnicity ws reclassified into four groups. There were 34 or 27.9 percent of the college students who reported their ethnic identity as African American and 44 or 36.1 percent who indicated their ethnic status as white. On the other hand, 33 or 27 percent of the participants identified their ethnic background as Hispanic American, and 11 or 8 percent expressed their ethnicity as Asian American. See Table 2 for these findings.

Table 2

Frequency Distribution of Participants by Ethnicity

Variable	Number	Percent
Ethnicity		
African American	34	27.9
White American	44	36.1
Hispanic American	33	27.0
Asian American	11	8.0
Total	122	100.0

Socio-Economic Status

The variable socio-economic status was categorized into five (5) income groups for the current investigation. Eighty or 5.6 percent of the college students revealed that their annual income was $10,000 or less and 22 or 18 percent reported their income was between $10,001 and $20,000. Likewise, 9 or 7.4 percent of the student participants indicated their annual income was between $20,001 and $30,000 and 4 or 3.3 percent expressed their annual income was between $30,001 and $40,000. Finally, 7 or 5.7

percent of the participants acknowledged their annual income as $40,001 or above. See Table 3 for these analyses.

Table 3

Frequency Distribution of Participants by Annual Income

Variable	Number	Percent
Income		
$10,000 or less	80	65.6
$10,000 to $20,000	22	18.0
$20,001 to $30,000	9	7.4
$30,001 to $40,000	4	3.3
$40,001 and Above	7	5.7
Total	122	100.0

Major Area of Study

Regarding the variable major area of study, there were 96 or 78.7 percent of the study participants who indicated their area of study was a STEM program. In comparison, 26 or 21.3 percent reported their area of study was a Non-STEM Program. See Table 4 for these findings.

Table 4

Frequency Distribution of Participants by Major Area of Study

Variable	Number	Percent
Area of Study		
STEM	96	78.7
Non-STEM	26	21.3
Total	122	100.0

Teaching Method

The variable teaching method was categorized into three groups. There were 81 or 66.4 percent of the participants who were exposed to the traditional method and 4 or 3.3 percent who were exposed to the online method. In addition, 37 or 30.3 percent of college students were involved with the hybrid method. See Table 5 for these results.

Table 5

Frequency Distribution of Participants by Teaching Method

Variable	Number	Percent
Teaching Method		
Traditional	81	66.4
Online	4	3.3
Hybrid	37	30.3
Total	122	100.0

Mean and Standard Deviation Results Regarding Independent and Dependent Variables

The means and standard deviations for the independent and dependent variables utilized in the regression model were obtained for the study (See Table 6). The mean perceived academic success in mathematics for college student was 77.72 (SD=11.27). Thus, as a group, college students had a somewhat favorable perception toward mathematics.

Moreover, the variables gender, ethnicity, academic major, college readiness, and type of instruction were dummy coded for this study. Regarding the variable gender, male was coded "1" and female coded "0." The variable ethnicity was created into four distinct variables for this investigation. The variable African American was coded "1" for African American and "0" for non-African American. The variable White American was coded "1" for White American and "0" for non-White American. The variable Hispanic American was coded "1" for Hispanic American and "0" for non-Hispanic American. In addition, the variable Asian American was coded "1" for Asian American and "0" for non-Asian American.

Furthermore, the variable type of instruction was recategorized into three factors. The variable traditional was coded "1" for traditional and "0" for non-traditional. The variable online was coded "1" for online and "0" for non-online. Also, the variable hybrid was coded "1" for hybrid and "0" for non-hybrid.

Finally, the variable academic readiness was coded "1" for yes and "0" for no. Likewise, the variable academic readiness was coded "1" for yes and "0" for no.

Table 6

Mean and Standard Deviation Results Regarding the Independent and Dependent Variables

Variables	Mean	Standard Deviation
Gender	.426	.496
African American	.278	.450
White American	.363	.483
Hispanic American	.270	.446
Asian American	.090	.287
Academic Major	.786	.411
Readiness	.688	.405
Traditional Method	.663	.474
Online Method	.032	.178
Hybrid	.303	.461
Tutoring	.385	.488
Cooperative	.525	.501
Perceived Math Success	77.720	11.272

Note: Readiness = Academic Readiness; Cooperative = Cooperative Learning

Correlational Results Pertaining to the Independent and Dependent Variables

Inter-correlation analyses (See Table 7) were computed among the eight independent variables and the dependent variable perceived academic success in mathematics. The Pearson Product Moment Correlation, the Point Biserial and Biserial Correlation Coefficient were employed to assess the relationship among quantitative and binary variables utilized in the study.

The personal related factor gender was found to be statistically related to the perceived academic success in mathematics ($r = .284$, $p < .01$). However, the personal related factors ethnicity was not found to be significant related to the perceived academic success in mathematics among college students.

Moreover, among the academic factors, academic major ($r = .288$, $P < .001$) and academic readiness ($r = .198$, $P < .05$) were found to be statistically related to the perceived academic success in mathematics of college students. In addition, type of instruction was found not to be significantly related to perceived academic success in mathematics among college students.

Finally, the service-related factor of cooperative learning was found to be statistically related to the perceived academic success in mathematics of college students ($r = .210$, $p < .05$). Nonetheless, the service related factor of tutoring was found not to be significantly related to the perceived academic success in math among college students.

Table 7

Correlation Results Regarding Independent and Dependent Variables

Independent Variable	Dependent Variable Perceived Academic Success in Math
Gender	.284**
African American	-.156
White American	.055
Hispanic American	.002
Asian American	.153
Academic Major	.288***
Readiness	.198*
Traditional	.095
Online	-.164
Hybrid	-.034
Tutoring	-.067
Cooperative	.210*

Note: Readiness: Academic Readiness; Cooperative: Cooperative Learning
*Significant at the .05 level
**Significant at the .01 level
***Significant at the .001level

Testing of Hypotheses

HO_1: There is no statistically significant relationship between personal related factors (gender and ethnicity) and the perceived academic success in mathematics among college students.

Presented in Table 8 were the Standard Multiple Regression findings with respect to the relationship between personal related factors of gender and ethnicities and the perceived academic success in mathematics among college students. The multiple regression model yielded a multiple correlation (R) of .330. The four personal related factors combined accounted for 10.9 percent (Adjusted = 7.8%) of the variance in the perceived academic success in mathematics of college students.

A statistically linear relationship existed between the personal related factors (gender, African American, White American, and Hispanic American) and perceive academic success in mathematics ($F(4,116) = 3.549$, $P < .01$). When the variables African American, White American, and Hispanic American were controlled, gender was found to contribute significantly to the perceived academic success in mathematics of college students. Therefore, hypothesis one was rejected.

Table 8

Multiple Regression Results Regarding the Relationship Between Selected Personal Related Factors and the Perceived Academic Success in Mathematics

Model	B	SE	Beta	t	P
(Constant)	81.388	3.410			
Gender	6.147	2.092	.270	2.092	.004***
African American	-6.995	3.815	-.277	-1.833	.064
White American	-5.520	3.672	-.236	-1.503	.135
Hispanic American	-5.238	3.782	-.207	-1.385	.169

Note: R=.330; R Square =.109; Adjusted R Square = .078; F = 3.549; df= 4,116; P =.009**
Reference Group = Asian American
**Significant at the .01 level

HO_2: There is no statistically significant relationship between academic related factors (academic major college readiness, and type of instructional methods) and the perceived academic success in mathematics among college students.

Shown in Table 9 were the Standard Multiple Regression Analyses pertaining to the predictable relationship between academic related factors (academic major, college readiness, and type of instructional methods) and the perceived academic success in mathematics among college students. The regression model resulted in a multiple correlation (R) of .388. The variables academic major, college readiness, traditional method and online method collectively were found to explain 15 percent (Adjusted = 12.1%) of the variance in the perceived academic success in mathematics of college students.

A significant linear relationship was found to exist between academic factors (academic major, college readiness, traditional method, and online method) and the perceived academic success in mathematics ($F(4,117) = 5.178$, $P < .001$). Furthermore, the variable academic major ($t(117) = 3.340$, $P < .001$) and college readiness ($t(117) = 2.359$, $P < .05$) contributed independently to the perceived academic success in mathematics of college students. Thus, hypothesis two was rejected.

Table 9

Multiple Regression Results Regarding the Relationship Between Selected Academic Factors and the Perceived Academic Success in Math

Model	B	SE	Beta	t	P
(Constant)	68.055	2.826			
Major	7.814	2.338	.285	3.340	.001***
Readiness	4.814	2.069	.201	2.359	.020*
Traditional	.720	2.102	.030	.343	.732
Online	-.983	5.565	-.156	-1.766	.080

Note: R =.388; R Square =.150; Adjusted R Square = .121; F =5.178; df = 4,117; P =.001***; Reference Group = Hybrid Method
*Significant at the .05 level
***Significant at the .001 level

HO_3: There is no statistically significant relationship between service-related factors (tutoring and, cooperative learning) and the perceived academic success in mathematics among college students.

Reported in Table 10 were the Standard Multiple Regression results regarding the predictable relationship between service-related factors of tutoring, and cooperative learning and the perceived academic success in mathematics among college students. The regression model yielded a multiple correlation coefficient (R) of .213. The two service-related predictors together accounted for 4.5 percent (adjusted = 2.9%) of the variance in the perceived academic success in mathematics of college students.

A significant linear relationship was not found to exist between service-related factors (tutoring and cooperative learning) and the perceived academic success in mathematics of college students (F (2,119) = 2.832, P >.05). Additionally, the variable cooperative learning was an independent predictor (t = 2.258) P <.01) of perceived

academic success in mathematics of college students. Consequently, hypothesis three was not rejected.

Table 10

Multiple Regression Results Regarding the Relationship Between Selected Service Factors and the Perceived Academic Success in Mathematics

Model	B	SE	Beta	t	P
(Constant)	75.20	1.753			
Tutoring	-.812	2.092	-.035	-.388	.698
Cooperative	4.613	2.039	.025	2.258	.026**

Note: R =.213; R Square = .045; Adjusted R Square = .029; F = 2.832; df = 2,119; P = .063
**Significant at the .01 level

Summary of the Hypotheses

Three null hypotheses were tested in this empirical study. All the hypotheses were tested for the relationship and predictive value of selected personal related factors, academic related factors, service-related factors, and the perceived academic success in mathematics among college students. Hypotheses one and two were found to be significant.

Relative to hypothesis one, the personal related factors of gender and ethnicity were found to be statistically related to the perceived academic success in mathematics of college students. Gender was found to be an independent predictor of perceived academic success in mathematics among college students.

Moreover, with respect to hypothesis two, the academic related factors of academic major, college readiness, and type of instructional methods were found to be statistically related to the perceived academic success in mathematics of college students. The variables academic major and academic readiness were found to be independent predictors of perceived academic success in mathematics among college students.

Finally, with regard to hypothesis three, tutoring and cooperative learning were found not to be significantly related to perceived academic success in mathematics of college students. The variable cooperative learning was found to be an independent predictor of the perceived academic success in mathematics among college students. See Table 11.

Table 11
Summary of All Hypotheses Tested

Hypotheses	R	R^2	F	df	Conclusion
HO_1	.330	.109	3.54**	4,116	Significant
HO_2	.388	.150	5.178***	4,117	Significant
HO_3	.213	.045	2.832	2,119	Non-significant

**Significant at the .01
***Significant at the .001

CHAPTER 5

SUMMARY, FINDINGS, DISCUSSIONS, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the predictable relationship between selected personal, academic, and service-related factors and the perceived academic success in mathematics among college students. Specifically, this study was concerned with the predictive value of the variables gender, ethnicity, academic major, academic readiness, type of instruction method, tutoring and cooperative learning for the perceived academic success in mathematics among college students.

A correlational research design was employed in the present study. One hundred twenty-two (122) college students attending two higher education institutions located in the southern region of the United States participated in the study. The instrument entitled a Modified Version of the Mathematics Attitude and Perceptions Survey was used to collect the data. The investigative instrument was found to have excellent content validity and a split half reliability coefficient of .823 for the instrument as a whole.

Finally, the data were analyzed through the application of the Pearson Product Moment Correlation, Biserial Correlation, Multiple Correlation, and the Standard Multiple Regression Procedures. The following null hypotheses were formulated and tested in this study:

HO_1: There is no statistically significant relationship between personal related factors (gender and ethnicity) and the perceived academic success in mathematics among college students.

HO_2: There is no statistically significant relationship between academic related factors (academic major, academic readiness, and type of instructional methods) and the perceived academic success in mathematics among college students.

HO_3: There is no statistically significant relationship between service-related factors (tutoring, cooperative learning) and the perceived academic success in mathematics among college students.

Findings

The following findings were obtained from the results of this empirical investigation:

1. A linear relationship was found to exist between the personal related factors of gender and ethnicity and the perceived academic success in mathematics of college students.
2. College students' gender was independently related to their perceived academic success in mathematics.
3. Academic factors of academic major, college readiness, traditional instructional method, and online instructional method were significantly related to the perceived academic success in mathematics of college students.
4. The variable academic major was an independent predictor of the perceived academic success in mathematics among college students.

5. The academic factor of academic readiness did contribute significantly to the perceived academic success in mathematics of college students.
6. A statistically significant linear relationship was not found to exist between the service related factors of tutoring and cooperative learning, and the perceived academic success in mathematics of college students.
7. The service-related factor of cooperative learning was found to be independently related to the perceived academic success in mathematics of college students.

Discussion

One of the most interesting findings of the present study was the significant influence of personal related factors on the perceived academic success in mathematics among college students. To be sure, the personal related factors of gender and ethnicity were found to have a linear relationship with perceived academic success in mathematics among college students.

Particularly, gender was found to be a significant independent predictor of perceived academic success in mathematics among college students. These findings were consistent with those of Gutpa, Harris, Carrier and Caron (2006), Ganley, George, Cimpion and Makowski (2018), Good et al. (2008), Lane et al. (2012), Else-Quest et al. (2010), Sainz and Eccles (2012), Nosek, et al. (2002), Jeff (2013), and Geddes (2015). All of the aforementioned researchers found that gender was significantly related to perceived academic success in mathematics. However, in their studies Walker and Plata (2000) and Perna et al. (2008) found that gender was not significantly related to perceived academic success in mathematics.

Likewise, the present study with regard to the gender findings revealed that male college students perceived more favorably their academic success in mathematics than their female counterparts. A substantial explanation for these findings may be that male college students tend to be more engaged in math courses whereas female college students seem to adhere to the stereotypical belief that they tend not to do well academically in mathematics. Because of this position, male college students seem to exhibit more positive attitudes towards mathematics and are more likely to perform better in this academic area than female college students.

Moreover, the variable ethnicity was linearly related to perceived mathematics success in conjunction with gender, but not as an independent predictor. These findings were not consistent with those of Bannister et al. (2007), Martin (2012), Walker and Plata (2002), McGee (2013, 2015), Roksu, Jenkins, Jaggars, Zeidenberg and Cho (2009) and Crisp, Reyes, and Doran (2017). All of the above researchers found that the variable ethnicity was found to be statistically related to mathematics success. An explanation for the present findings may be that regardless of the college students' ethnicity they seem to possess similar perceptions with respect to their ability to be successful in mathematics.

Another notable finding of the current investigation was the significant impact of academic related factors on the perceived academic success in mathematics among college students. Specifically, the academic related factors of academic major, college readiness, and type of instructional method were found to have a predictable relationship with perceived academic success in mathematics.

Further, of the aforementioned academic related factors, academic major (STEM or Non-STEM) was found to have the highest amount of predictive power regarding perceived mathematics success among college students. These findings were supported

by the works of Perna et al. (2008), Kimbrough and Harper (2006) and Jeff (2013). The previous researchers found that academic major was significantly related to mathematics success among college students. A reasonable explanation for these findings may be that college students who majored in a STEM academic area perceived that they were more academically prepared as well as more capable of doing mathematics than may be those students who majored in a non-STEM academic field.

Additionally, the academic related variable college readiness was also found to be an independent predictor of perceived academic success in mathematics among college students. These findings were favorable to those by Corbishley and Troxman (2010), Gillard, Robathan, Willison, and Salkinor (2011), and Salkino and Burukhin (2009). The above researchers found that the variable college readiness was related to mathematics success. A subjective explanation for these findings may be that college students who were exposed to quality instruction in high school math that places emphasis on critical thinking and problem solving are the ones who perceive that they would be successful in mathematics in college.

Also, the academic factor type of instructional method was found not to be an independent predictor of perceived academic success in mathematics. These findings did correspond to those of Bendrickson (2004), Summers et al. (2005), Herman and Banister (2007), and Frank (2012). Nonetheless, the type of instructional method findings did not correspond to those by Ashby et al. (2011), Peterson and Bond (2004), Lack (2013), Nguyen (2015), Driscoll et al. (2012), Collins (2014), Romero and Usart (2014) and Xu and Jaggars (2013). The above-mentioned researchers either found little or no relationship or a significant relationship between type of instructional method and mathematics success. A valuable explanation for these findings may be that college

students surveyed in this study might have similar work habits and learning styles in the area of mathematics. Because of this, they had similar perceptions regarding academic success in mathematics.

Perhaps the most surprising finding in the present study was the significant independent influence of the service-related factor cooperative learning on the perceived academic success in mathematics among college students. The variable cooperative learning was found to be an independent predictor of perceived academic success in mathematics. These findings were consistent with those of Zakaria, Chin, and David (2010). Shavghnessy (1997), and Garfield (1993). The aforementioned researchers found that the variable cooperative learning was related to academic success. An explanation for these findings may be that college students who are able to work independently in math are also those who have less anxiety about math. Because of this, they have a more positive perception about being successful in math than those who work in groups.

Finally, another somewhat astonishing finding of the current study was the lack of predictive power that the service-related factor tutoring had on the perceive academic success in mathematics among college students. These findings were not supported by the works of Pell and Croft (2008), Dowling and Nolan (2006), Rheinheimer, Grace-Odeleye, Francois, and Kusorgbor (2010), Parkinson (2009), Cheng and Walter (2009), and Marx et al. (2016). The above researchers found a significant relationship between tutoring and the academic success in math among college students. A plausible explanation for these findings may be that college students who needed and received tutoring were enthusiastic about learning math in their sessions. This probably helped them to reduce their degree of math anxiety, and, in the long run, helped how they perceived their success in mathematics.

Conclusions

The following conclusions were drawn from the results of this study:

1. In general, it appeared that any regression model developed to predict the perceived academic success in mathematics of college students should include the personal related factors of gender and ethnicity.
2. Male college students exhibited significantly more favorable perceptions toward mathematics than female college students.
3. It appeared that any regression model developed to predict the perceived academic success in mathematics of college students should include the academic factors of academic major, academic readiness, traditional instructional method, and online instructional method.
4. College students who had a STEM major possessed significantly more favorable perceptions regarding mathematics than their counterparts who had a non-STEM major.
5. College students who indicated that they were college ready had a 4.88 higher perception score regarding their mathematics success than those college students who reported they were not college ready.
6. In general, it appeared that any attempt to develop a regression model to predict the perceived math success in mathematics should not include the service-related factors of tutoring and cooperative learning.
7. Finally, the service-related factor of cooperative learning was found to be an independent predictor of the perceived academic success in mathematics of college students. College students who work math independently had more favorable perceptions regarding being successful in mathematics.

Implications

The following implications were drawn from the results of the study.

1. The significant impact of demographic factors on the perceived academic success in mathematics among college students suggests that college officials who are responsible for the academic side of the institution should implement various strategies to alter the perceptions of students toward mathematics. An awareness of the predictive power that demographic factors have on how college students perceive their success in mathematics will provide college administrators with vital information to identify those types of students who probably will have academic difficulties in math courses.
2. The academic related factors and their influence on the perceived academic success of college students suggest that an infusion of effective and quality instructional programs geared toward critical thinking will be important in enhancing the overall mathematical ability of students. It is imperative that the math faculty and the academic administrators continue to emphasize the importance of developing the problem-solving skills of students for the purpose of improving their ability to achieve success in mathematics.
3. Finally, the lack of a predictable relationship between service-related factors and their influence on the perceived academic success in mathematics of college students highlighted the significant of these factors in understanding how students will perform in mathematics. Understanding the causal effects of these variables in conjunction with other variables associated with math performance can give a more parsimonious picture of their effects on the math preparations of college students.

Recommendation for Further Study

Based on the findings of this study the following recommendations are offered:

1. A follow up study should be conducted to include a much more global population from various geographic regions of the United States. Such a study will provide more relevant data on the perceived academic success in mathematics among college students.
2. A study should be conducted to examine the interaction effects between demographic, academic, and service-related factors and the perceived academic success in mathematics among college students.
3. A study should be conducted to investigate further the impact of instructional methods in conjunction with instructional programs on the academic performance of college students in STEM majors other than mathematics.
4. Finally, a study needs to be conducted to determine the effect of psychological and emotional factors on the mathematics performance of college students.

APPENDIX

APPENDIX A

MODIFIED VERSION OF THE MATHEMATICS ATTITUDES AND PERCEPTIONS SURVEY

Modified Version of the Mathematics Attitudes and Perceptions Survey

The purpose of the instrument is to compile student background information that will help the College of Education and the Math Department provide better support for student success in mathematics.

Directions: Please provide the appropriate response for each item.

Part I. Personal Characteristics

1. **What is your Gender?**

( ) Male

( ) Female

2. **What is your ethnicity?**

( ) African American

( ) White (Caucasian)

( ) Hispanic

( ) Asian

( ) Other (Please Specify) _____

3. **What is your annual income?**

( ) 10,000 or less

( ) 10,001 to 20,000

( ) 20,001 to 30,000

( ) 30,001 to 40,000

( ) 40,001 and above

Part II. Academic Characteristics

4. **What is your major area of study at the university?**

( ) STEM

( ) Non-STEM

5. **I believe that my math curriculum in High School prepared me to be successful in math.**

( ) Yes

( ) No

6. **I believe that positive classroom environment is important in a math class?**

( ) Yes

( ) No

7. **Which of the following is the most effective teaching method in math?**

( ) Traditional Lecture

( ) Online

( ) Hybrid (Some lecture some online)

Part III. Service Characteristics

8. **Which is the best way for you to be successful in your math class?**

( ) Working independently

( ) Working in groups

9. Have you received tutoring in your math class?

( ) Yes

( ) No

Part IV. Perceptions Toward Mathematics Success

Direction: Below you will find twenty (20) statements regarding the perceptions of students regarding being successful in Mathematics. You are to check the appropriate response on the following scale representing your perception regarding the statement.

Strongly Agree (5) Agree (4) Neutral (3) Disagree (2) Strongly Disagree (1)

I BELIEVE THAT I WILL BE SUCCESSFUL IN MY MATH COURSE IF:

10. I am capable of understanding math when I work at it. ___ ___ ___ ___ ____

5 4 3 2 1

11. I enjoy solving math problems. _____ _____ _____ _____ _____

5 4 3 2 1

12. I am able to make sense out of formulas and procedures before I use them.

____ ____ ____ ____ _____

5 4 3 2 1

13. I am able to understand the reasoning skills to do math. ___ ___ __ ___ ____

5 4 3 2 1

14. By understanding math, it will change my ideas about how the world works.

____ _____ _____ _____ _____

5 4 3 2 1

15. By learning something new in math, it will help me to relate to what I already know.

_____ _____ _____ _____ _____
5 4 3 2 1

16. I can learn different approaches in solving a math problem. __ ___ __ ___ ___

17. I am able to figure out a way to solve math problems. **5 4 3 2 1** __ ___ ___ ___ ____

18. I am able to understand the concepts in math. **5 4 3 2 1** ___ ___ ___ ___ ___

19. I am able to organize my thoughts during a math test. **5 4 3 2 1** ___ ___ ____ ____ ____

20. I am able to be confident when taking math tests. **5 4 3 2 1** ___ ___ ___ ____ _____

21. I am capable of solving math problems that are similar to examples given in class or textbook.

_____ _____ _____ _____ _____
5 4 3 2 1

22. I am able to recall information given in class while taking a math test.

_____ _____ _____ _____ _____
5 4 3 2 1

23. I am capable of doing math problems since my ability in math has improved.

_____ _____ _____ _____ _____
5 4 3 2 1

24. By understanding the math topic I can work the exercise given in the textbook.

_____ _____ _____ _____ _____
5 4 3 2 1

25. By showing intermediate steps in solving a math problem I can find the correct answer.

_____ _____ _____ _____ _____
5 4 3 2 1

26. I am capable of understanding where a math formula comes from in order to solve a problem.

_____ _____ _____ _____ _____
5 4 3 2 1

27. Being stuck on a math problem will eventually improve my math skills.

_____ _____ _____ _____ _____
5 4 3 2 1

28. By having the necessary formula I can solve a math problem.

_____ _____ _____ _____ _____
5 4 3 2 1

29. I will learn math even when it is not required. ___ ___ ___ ___ ___
5 4 3 2 1

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