THE DIFFERENCES BETWEEN COLLEGE READINESS AND THE TYPE OF

ALGEBRA 1 COURSE TAKEN BY MALE AND FEMALE STUDENTS ATTENDING A

PRIVATE SCHOOL IN SOUTHWESTERN VIRGINIA

by

Christina M. Perdue

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Liberty University

2019

THE DIFFERENCES BETWEEN COLLEGE READINESS AND THE TYPE OF

ALGEBRA 1 COURSE TAKEN BY MALE AND FEMALE STUDENTS ATTENDING A

PRIVATE SCHOOL IN SOUTHWESTERN VIRGINIA

by

Christina M. Perdue

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

Liberty University, Lynchburg, VA

2019

APPROVED BY:

Philip R. Alsup, Ed.D., Committee Chair

Kurt Y. Michael, Ph.D., Committee Member

ABSTRACT

Algebra 1 is a foundational course for all higher mathematics. Research suggests taking rigorous math courses earlier in a student's education increases college readiness which leads to a greater economic impact to the community. The purpose of this quantitative causal-comparative study was to determine if there is a difference between male and female students' college readiness as measured by the mathematics test scores of the PSAT/NMSQT of students who have taken an Algebra 1 course, designated as either Honors or Non-Honors section, who attend a private high school. Having early indications of college readiness allows students more time to develop the skills necessary to be successful in college and reduce the need for remedial courses. The study used archival data of a convenience sample of 166 10th-grade participants to determine differences in college readiness between the Honors and Non-Honors Algebra 1 male and female students. A two-way ANOVA was conducted to analyze the differences and interactions between the groups. The results revealed there is a statistically significant difference in the college readiness of students who took Honors Algebra 1 than those who did not. There was no statistically significant difference in college readiness found between genders. Recommendations for future research include investigating the college readiness for students who stay on the Honors track past Algebra 1 and the differences in college readiness between students who take Honors English and those who do not.

Keywords: mathematics and college readiness, Honors Algebra 1, math education, private school education, gender and mathematics college readiness

Dedication

First, I would like to thank God for placing a desire in me to be a life-long learner and giving me the strength and patience to persevere through the last ten years to complete this work. I dedicate this work to my husband, Travis, for having faith in me and encouraging me to continue to completion even after many stumbling blocks led me to take pauses from my work. I dedicate this work to my children, Kaylyn, Elizabeth, and Gillian who always supported me. May this work prove to you that you can accomplish your goals as long as you never quit and trust in God to make a way! I dedicate this work to my parents, parents-in-law, and grandparents who have helped me financially, helped with childcare, and encouraged me to always pursue my dreams and goals. You never lost faith in my ability to persevere and see this goal to completion.

Acknowledgments

First, I would like to acknowledge my committee members for all of their support and assistance in helping this goal become a reality. To Dr. Philip Alsup, my chair, I thank you for your guidance and patience as you helped me to move through the dissertation process. Your encouragement and thorough explanations allowed me to persevere to complete this study. To my research consultant, Dr. Kurt Michael, I appreciate your willingness to be direct and help me find a feasible study from the beginning of my dissertation journey and to understand the statistical analysis process. You have a unique gift to make statistics seem easy to interpret in a practical way. Thank you to my friends, Dr. Daniel Murphy and Dr. Tracy Turner, for paving the way before me and allowing me to pick your brains about this process. You gave me hope to know that this life-long goal was within reach. Finally, to my fellow teachers, you have all prayed, supported, and encouraged me along this journey, so I thank you. I know there are a few of you that will be finishing your doctorates in the near future, so I will be giving you the same encouragement and support as you finish your goals.

Table of Contents

List of Abbreviations

Advanced Placement (AP)

Analysis of Variance (ANOVA)

Grade Point Average (GPA)

Institutional Review Board (IRB)

International Baccalaureate (IB)

National Assessment of Educational Progress (NAEP)

National Center for Educational Statistics (NCES)

National Merit Scholarship Qualifying Test (NMSQT)

No Child Left Behind (NCLB)

Preliminary SAT (PSAT)

Scholastic Aptitude Test (SAT)

Science, Technology, Engineering, and Math (STEM)

Socioeconomic Status (SES)

Standard Error of Measurement (SEM)

Statistical Package for the Social Sciences (SPSS)

Trends in International Mathematics and Science Study (TIMSS)

Virginia Standard of Learning (VA SOL)

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

Overview

Algebra 1 is a foundational course for all higher mathematics. Research suggests taking rigorous math courses earlier in a student's education can lead to an increase in college readiness. This study investigated the difference among college readiness as measured by the mathematics portion of the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT) and the type of Algebra 1 course taken, designated as Honors or Non-Honors, for male and female private school students. Chapter One presents the background, problem statement, purpose, significance of the study, theoretical framework, and research questions for the study.

Background

Mathematics has been shown to be a key indicator of college readiness with increased rigor having a positive impact on readiness (Hein, Smerdon, & Sambolt, 2013). Students that participate in rigorous math courses such as Honors, dual enrollment, and Advanced Placement (AP) show the highest measures of college readiness as indicated by college entrance exams such as PSAT/NMSQT, Scholastic Aptitude Test (SAT), and ACT exams (Camara, 2013; Giani, Alexander, & Reyes, 2014; Hein et al., 2013). Participating in rigorous math courses earlier in secondary school allows students to enroll in higher-level, college-preparatory courses while in high school. Taking upper-level courses ensures not only college readiness but has also been shown to increase the probability of baccalaureate degree attainment and overall postsecondary success (Adelman, 2006; Kaliski & Godfrey, 2014; Martinez & Klopott, 2005; Royster, Gross, & Hochbein, 2015). The relationship between mathematics and college readiness is explained as the increased ability to use critical thinking and persevere through a challenging rigorous

curriculum (Cromwell, McClarty, & Larson, 2013; Sciarra, 2010). Several large studies have shown a direct relationship between participating in higher levels of mathematics and college readiness (Cromwell et al., 2013; Giani et al., 2014; Long, Iatarola, & Conger, 2009; Sciarra, 2010).

Gender differences in students' college readiness have been an area of interest as well. In the 1980s and 1990s, research found that male students were receiving higher college entrance exam scores mainly due to higher mathematics sub-tests (Harris & Carlton, 1993). In 1993, further research indicated that males showed an interest in applied mathematical problems such as real-life word problems and females tended to do better with more abstract Algebra computations (Harris & Carlton, 1993). Efforts were made to analyze the college entrance exams for bias and increase female student involvement in higher science, technology, engineering, and mathematics courses. Casey, Nuttall, and Pezaris' (1997) study showed that there was only a slight advantage in males' mathematics college entrance exams scores overall, but that a larger gender discrepancy was found as the highest achievers scores were analyzed. The reasoning for the discrepancy was better spatial awareness skills for males versus females necessary in problem-solving strategies (Casey et al., 1997). Data from the 2003 Trends in International Mathematics and Science Study (TIMSS) showed very little difference in math college readiness between genders (Else-Quest, Hyde, & Linn, 2010). In 2010, a study found that male students had slightly higher SAT scores over female students, but the gender gap was decreasing (Combs et al., 2010). Nankervis (2013) found males had slightly higher 2010 PSAT scores giving males an advantage in the National Merit Scholarship competition. However, a more recent study showed no significant differences in male and female scores on a college readiness test (Houser & An, 2015). This change could be due to the increase of females

participating in college preparatory courses in recent years, such as higher mathematics, closing the achievement gender gap (Long et al., 2009).

College readiness has long been an issue for higher education institutions. In order to encourage students to attend higher education institutions, the College Board Entrance Examination Organization (College Board, 2018) was formed to simplify the college admissions process in early 1900. Several college entrance exams have been created to help college administrators evaluate student college readiness including the SAT and the ACT test. Most colleges today use a combination of high school grade point average (GPA), college entrance exams, and the level of course rigor taken by students (Camara, 2013; Cromwell et al., 2013; Hein et al., 2013; Sciarra, 2010). There has also been a renewed interest at the national level to create students who are college and career ready where policies have been enacted for a direct impact on students, teachers, and society (U.S. Department of Education, 2010).

Many schools are trying to track the college preparedness of students at earlier ages as well. The Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT) is used to measure early indicators of college readiness for students, mainly in the 10th and 11th grade, although some students take it earlier (Milewski & Sawtell, 2006). The SAT and PSAT/NMSQT are used to quantify students' college readiness as a composite score which is a sum of the reading and mathematics subscales (College Board, 2017). The PSAT/NMSQT has also been used to identify students that need early intervention supports and those that are ready for more challenging coursework (College Board, 2017). The 10th and 11th graders taking the PSAT/NMSQT get a strong and reliable early indicator of college readiness (Proctor, Wyatt, & Wiley, 2010). Students that meet the PSAT/NMSQT and SAT college readiness benchmarks

have a 90% enrollment in four-year college institutions and a high rate of degree attainment

(Wyatt, Smith, & Proestler, 2014).

Societal benefits of a college education include economic impact for participants.

College-educated students earn more income versus those who only obtained a high school

diploma. In 2007, males earned 79% more income with a college degree and females earned

92% more income over those without a degree (Danziger & Ratner, 2010). Students who engage

in rigorous mathematics courses have been shown to have higher college readiness rates and also

have a higher probability of earning a four-year degree which leads to higher income potential

(Camara, 2013; Gianni et al., 2014; Hein et al., 2013; Kaliski & Godfrey, 2014; Martinez &

Klopott, 2005). Students who are on-track for college readiness early, as indicated by

PSAT/NMSQT scores, have been shown to attend four-year colleges 89% of the time with 58%

of those students graduating in four years (Wyatt et al., 2014). This study gives school

counselors more information on how higher-level math courses affect college readiness for their

students (Bryan, Young, Griffin, & Henry, 2015).

The foundational theories supporting academic rigor as an indicator of college readiness

stem from the work of Dweck and Leggett (1988) and Bandura (1977, 1993). Dweck and

Leggett's (1988) incremental intelligence theory suggests that students who believe that

intelligence is malleable have a higher self-efficacy, will choose challenging coursework, and are

able to persevere toward academic success (Dweck, 2009; Dweck & Leggett, 1988). A current

trend in education is Dweck's growth mindset which encourages students to continue to pursue

challenging studies as a means to increase intelligence (Dweck & Leggett, 1988). A recent study

found students who espouse to incremental intelligence theory have greater school persistence

regardless of gender (Renaud-Dubé, Guay, Talbot, Taylor, & Koestner, 2015). Self-efficacy

theory was examined and reported by Bandura. Bandura (1977) defined self-efficacy as a person's beliefs about his or her ability to succeed in a specific task. His theory of self-efficacy relates to achievement because an individual students' self-efficacy will determine choices that lead one to participate in rigorous courses as a means to better oneself (Bandura, 1977, 1993). Self-efficacy has also been shown to influence college perseverance and degree attainment (Giani et al., 2014). These theories help to ground the study investigating students' participation in courses of higher rigor in foundational mathematics compared to courses of average difficulty. If students are participating in higher-level courses because of self-efficacy, then they are preparing themselves for college early and increasing their knowledge in an effort to achieve academic success.

Many studies have used gender as a component in research as it has been a variable of interest through the years (Casey et al., 1997; Michael & Alsup, 2016; Niederle & Vesterlund, 2010). The gender component of this study is supported by gender schema theory. Bem's (1981) gender schema theory suggests that gender roles are adopted by young children as a result of cultural and societal norms classifying specific attributes or concepts as being either masculine or feminine. For instance, the subjects of math and science and occupations that utilize those topics have been linked to a masculine sex-type which may hinder females from pursuing higher-level courses because of their association with a non-traditional role (Cheryan, 2012). However, even in 1997, a contradicting study showed that females participating in a college-preparatory upper-level math course showed higher levels of feminine orientation than females in a cosmetology group (Wulff & Steitz, 1997). Recently, females have increased the number of math and science courses they are taking, and the math test score gap between males and females has been closing (Niederle & Vesterlund, 2010). Therefore, examining how gender

sex-typing interplays with growth mindset and self-efficacy may offer insight into the differences between male and female students' participation in rigorous Algebra 1 courses and their measure of college readiness.

Problem Statement

A college degree is one of the most important aspects of financial success in current times. The government also recognizes the need for individuals to obtain a college degree and is advocating for students to be college-ready on completion of secondary school (U.S. Department of Education, 2010). With 40% of students needing remedial coursework as they enter college, schools need to find a way to ensure students are prepared for the rigors of college study before high school graduation (Conley, 2007). Efforts have been underway to determine who is most prepared and what courses offer the best opportunity for students to be college-ready. Research with public school students indicates participating in rigorous mathematical coursework is linked to college readiness (Cromwell et al., 2013; Houser & An, 2015; McCormick & Lucas, 2011; Sciarra, 2010). The students who take Honors, Advanced Placement (AP), or dual enrollment classes in math have shown increased levels of college preparedness and do not have to take remedial courses upon entering college (Camara, 2013; Cromwell et al., 2013; Hein et al., 2013; Long et al., 2009; Wiley et al., 2011). There is a positive correlation with students participating in advanced rigorous math backgrounds, such as Honors, AP, and courses above Algebra 2, and persistence in college to obtain a baccalaureate degree (Conley & McGaughy, 2012; Sciarra, 2010). Research has also suggested that AP/Honors coursework has no bearing on the level of college preparation and degree attainment (Geiser & Santelices, 2004). This contradiction of studies shows a need to continue research in this area to confirm how rigorous coursework affects a student's level of college readiness.

Compared to research in public education, a relatively limited number of studies have been conducted concerning private schooling. One limitation surrounding private K-12 education research is the smaller student population which may not always meet statistical effect size parameters (Murnane, 1984). There are almost 35,000 private schools in the United States, and students that graduate from a private high school are significantly more likely to attend college (Broughman, Rettig, & Peterson, 2017; Jerrim, Parker, Chmielewski, & Anders, 2015). Some studies have found that students from private schools have higher achievement versus their public school counterparts while others show differences are removed once specific characteristics are controlled in the study (Jerrim et al., 2015; Lubienski & Lubienski, 2006). Examples of these characteristics include family background and initial achievement.

While research has identified rigorous math curriculum as a good indicator of college readiness for public school students, there is a lack of literature that represents special student populations such as private schools (Hein et al., 2013; Lee, 2012). More research is needed regarding predictive studies in differentiated institutions, such as private schools, for measuring college readiness (Camara, 2013; Hein et al., 2013). The contradictory studies on rigorous coursework and gender differences warrant extended research as well (Combs et al., 2010; Geiser & Santelices, 2004; Wighting, Nisbet, & Spaulding, 2009). The problem is that more research is needed relating to the private school population to understand differences in college readiness when mathematical course rigor is considered especially among male and female students.

Purpose Statement

The purpose of this quantitative causal-comparative study was to determine if there is a difference between male and female students' college readiness as measured by the mathematics

portion of the PSAT/NMSQT scores of students who have taken an Algebra 1 course designated as either a Non-Honors or Honors section, who attend a private high school. The dependent variable is college readiness as measured by the mathematics PSAT/NMSQT test score. College readiness is defined as the level of preparation a student needs in order to enroll and be able to take the next course in the sequence, without remediation, in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program (Conley, 2007). The PSAT/NMSQT test score has been used as an early measure of college readiness to determine if 10th- and 11th-grade students are on track for college success (Proctor et al., 2010). The first independent variable was the type of Algebra 1 course in which students participate. The two course sections available to students were the Honors Algebra 1 course or the Non-Honors Algebra 1 course. The Honors Algebra 1 course was considered more rigorous. Rigor is defined as the level of cognitive demands of instructional tasks during instruction for mathematical understanding (Boston & Wolf, 2006). According to the school's program of studies, while students learn similar topics in both Algebra 1 courses, the Honors Algebra 1 course incorporates a higher level of critical thinking, non-calculator computations, justification of procedures, and includes extra topics that the Non-Honors Algebra 1 course section does not cover. The second independent variable was the gender of the student which was self-reported on admission paperwork entering the private school and on the PSAT/NMSQT test. The study used archival data which includes all students in the 10th grade from a large private high school in southwestern Virginia enrolled in the 2017-2018 school year.

Significance of the Study

The significance of this study will be to add to the body of knowledge on college readiness by exploring the differences among Algebra 1 course type of male and female students in private high schools. Private school research studies are underrepresented in the literature. This may be due to the smaller sample pool to complete data analysis. Some research studies have included private schools where the data has been aggregated with public schools such as gaining information from College Board (Hein et al., 2013; Sciarra, 2010). However, even when private school student information is combined with public school, the percentage of private school information used is very low, making generalization limited. By focusing research on only private school education data, new insight will be added to the literature comparing private and public education.

Several studies suggest that while there is still a gender gap in mathematics achievement, the gap may have more to do with socioeconomic status (SES) than biological sex (Beekman & Ober, 2015; Houser & An, 2015). Studying the differences in college readiness in male and female students in a private school setting helps to control for students' SES. The debate over educational institutions' academic performance and claims of increased rigor in private schools has also been challenged in recent years (Lubienski & Lubienski, 2006). Lubienski's and Lubienski's (2006) study suggests that while private school academic achievement numbers are higher than some public schools, the students are coming into school with more advantages and a higher initial amount of learning which negates the effect of private education on student learning. If the current research findings agree with previous research, then getting students to participate in Honors Algebra 1 should be a priority for schools to increase college readiness. It may also open discussion on whether having pre-requisites to enter Honors Algebra 1 is wise

because merely participating in the course could yield a better prepared college student. This research study will add to the literature that has been completed for public school data showing that participating in a rigorous Algebra 1 course leads to increased college readiness for male and female students providing private school participants with a justification for enrolling in higher-level math courses.

Research Questions

RQ1: Is there a statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not?

RQ2: Is there a statistically significant difference in college readiness between male and female Algebra 1 students in a private high school?

RQ3: Is there a statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not?

Definitions

1. *College Board* – A non-profit member organization formed in 1900 to help simplify the college admissions process including test development, guidance, financial aid, and other educational services (College Board, 2018).

2. *College Readiness* – The level of preparation a student needs in order to enroll and be able to take the next course in the sequence, without remediation, in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program (Conley, 2007).

3. *Gender Gap* – Differences between academic achievement among males and females on a variety of measures across subject areas and aptitudes (Combs et al., 2010).

4. *Honors Course* – Common label for an advanced level course considered to be more academically rigorous than a Non-Honors course (Casad, Hale, & Wachs, 2017).

5. *Private School* – A school that is not supported primarily by public funds which provides classroom instruction for one or more of grades K–12 and has one or more teachers (Broughman et al., 2017).

6. *PSAT/NMSQT* – Preliminary SAT and National Merit Scholar Qualifying Test created by College Board as an early indicator of college readiness for high school students (Milewski & Sawtell, 2006).

7. *Rigor* – Students must be exposed to a rich knowledge core that is organized around the mastery of major concepts that provide students with regular opportunities to pose and solve problems, formulate hypotheses, justify their reasoning, construct explanations, and test their own understanding (Boston & Wolf, 2006).

8. *Secondary School* – School between elementary school and college usually offering general, technical, vocational, or college-preparatory courses, also commonly referred to as middle or high school (Focareto, 2006).

CHAPTER TWO: LITERATURE REVIEW

Overview

This study will look at the differences among college readiness and Algebra 1 course type of male and female students enrolled in a private high school located in a southeastern state. Understanding the background and literature linked to college readiness, course type rigor, and gender differences will give a firm foundation and direction for this study. Chapter Two will discuss the theoretical framework and related literature pertaining to the study and show a reason for continued research on this topic.

Theoretical Framework

The foundational theories that explain students' willingness to participate in rigorous coursework to achieve academic success include incremental intelligence theory, self-efficacy theory, and gender schema theory (Bandura, 1977; Bandura & Wood, 1989; Bem, 1981; Dweck 2009; Dweck & Leggett, 1988). Understanding if rigorous coursework earlier in a student's school experience can increase college readiness is necessary to help guide students in appropriate course decisions for their goals. This section examines the work of Dweck, Bandura, and Bem to give a foundation and direction for the current study.

Incremental Intelligence

Carol Dweck has extensively researched theories based on an individual's perception of the malleability of intelligence (Dweck, 2009; Dweck & Leggett, 1988). Her theory of implicit intelligences is comprised of two opposing belief systems, entity theory, and incremental theory. Persons that hold to the belief that intelligence is a fixed entity, cannot be changed over time, typically have performance-related goals and are said to prescribe to the entity theory of intelligence (Dweck & Leggett, 1988). Individuals that believe intelligence is malleable, can be

changed through effort and time, are oriented with learning goals and are said to prescribe to the incremental theory of intelligence (Dweck & Leggett, 1988). Each of these theories of intelligence have been tested over time, and show that students who fall into the incremental intelligence theory choose to take challenging courses, persevere through obstacles, and have higher academic achievement as measured by grades and test scores (Blackwell, Trzesniewski, & Dweck, 2007; Claro, Paunesku, & Dweck, 2016; Dweck, 2009, 2014; Dweck & Leggett, 1988; Good, Aronson, & Inzlicht, 2003; Renaud-Dubé et al., 2015). Claro et al.'s (2016) research shows that having a growth mindset, another term for incremental theory, can even help offset the effects of low SES on academic achievement. These studies have led to the incorporation and popularization of Dweck's growth mindset theory into teacher professional development programs and is used extensively in classrooms today (Sparks, 2013).

The theory of incremental intelligence began to take shape through Dweck's multiple psychological studies (Dweck & Leggett, 1988). Two behavior patterns emerged in these studies, the helpless pattern and the mastery-oriented pattern. The helpless pattern consisted of avoiding challenge and deterioration of performance when faced with obstacles, and the mastery-oriented pattern showed seeking challenging tasks with performance continuation even through conditions of failure. These two patterns were found to be most interesting because the behavior patterns did not depend on the ability of the child (Dweck & Leggett, 1988). In fact, some of the most skilled students exhibited the helpless pattern and those that prescribed to this pattern seemed to behave in ways that limited their ability and growth. Because of the anomaly in children's ability versus their behavior pattern, a more general conceptualization of performance goals and learning goals emerged. Those with performance goals were associated with having a fixed mindset regarding intelligence, and those with learning goals conceived intelligence to be

malleable or having a growth mindset (Dweck & Leggett, 1988). Blackwell et al. (2007) pointed out that prescribing to incremental theory, or growth mindset, "Does not imply that everyone has exactly the same potential in every domain or will learn everything with equal ease. Rather, it means that for any given individual, intellectual ability can always be further developed" (p. 247).

Research has shown teaching incremental theory has benefits for the early adolescent students as well as college students in both increased motivation and increased achievement (Aronson, Fried, & Good, 2002; Blackwell et al., 2007; Good et al., 2003; Yeager & Dweck, 2012). Aronson et al. (2002) found that teaching college students incremental theory of intelligences increased achievement over both no treatment and multiple intelligence training. Good et al. (2003) found that incremental intelligence intervention led to significant academic improvement for adolescents, but it did not address any motivational factors.

Blackwell et al. (2007) followed 373 middle school students in four cohorts for two years each in their study to assess the relation of an individual's mindset to their mathematics achievement and motivation. The study analyzed the mindset of beginning seventh-grade students and how it affected the achievement through the end of their eighth-grade year. In a secondary study, Blackwell et al. (2007) also used an intervention on struggling students teaching incremental intelligence theory, growth mindset, to determine if the intervention could reverse declining achievement in the junior high students. The results of the study found that incremental theory, growth mindset, has a positive association on effort, learning goals, and the use of different strategies in response to failure and was a significant predictor of mathematics achievement even to the end of the eighth grade. The results also showed that students who held to the incremental theory had a greater motivational framework that increased their achievement

over students prescribing to entity theory. In fact, even though students' math achievement scores were not significantly different as they entered the seventh grade, over the two years of the study, those with growth mindset began to pull apart mainly due to their ability to stay motivated and increase effort even through challenge and failure (Blackwell et al., 2007). In the secondary study involving lower-achieving students, Blackwell et al. (2007) found that the intervention did increase the number of students that held a growth mindset, and of the two groups, 27% of the intervention group showed motivational improvement compared to only 9% of the control group which was a statistically significant difference at $p < .05$. Regarding achievement for the intervention group, the initial decline continued for the first few months; however, after a few months the decline was halted for the intervention group while the control group's achievement continued to decline throughout the study and mirrored a typical junior high transition. Blackwell et al.'s (2007) research results show that having a growth mindset can not only help with student's achievement and motivation, but it can be taught and help improve student's perceptions and increase motivation and achievement.

Growth mindset has been shown to be a key indicator affecting college readiness as well. David Conley (2007) described the key foundation of college readiness as habits of mind. Conley (2007) gave seven intelligent behaviors necessary for college readiness including intellectual openness, inquisitiveness, analysis, reasoning and proof, interpretation, precision and accuracy, and problem-solving. Each of these behaviors is a set way of thinking that includes learning goals such as challenging one's self, looking for multiple strategies, applying problem solving and critical thinking skills, and a thirst for increasing and deepening one's own knowledge and understanding through challenging coursework that would be congruent with incremental intelligent theory (Conley, 2007; Dweck & Leggett, 1988).

Romero, Master, Paunesku, Dweck, and Gross (2014) found that there were no gender differences in intelligence theories. Mathematics is a subject most associated with students engaging in an entity or fixed intelligence mindset, yet it is necessary for students to engage in deep learning strategies and apply conceptual understandings in order to be considered college-ready (Conley, 2007; Dweck, 2014). Students who have been shown to take rigorous math courses and achieve academic success typically have been associated with growth mindset and being oriented toward learning goals rather than performance goals (Romero et al., 2014). Students with these attributes achieve academic success in math just by participating in challenging courses and have the ability to recover from initial failings on a test or course (Blackwell et al., 2007; Dweck, 2014; Grant & Dweck, 2003; Yeager & Dweck, 2012). Dweck (2014) also noted that disparities in math and science achievement could be significantly improved through the encouragement of a growth mindset. She cited several studies which found that females and minorities who held a growth mindset were less susceptible to the negative effects of stereotypes, received higher grades, and, by having a growth mindset, felt encouraged to continue in the field of math or science (Dweck, 2014). Romero et al. (2014) also showed that middle school students could change their mindset over time and that not only a student's grades would improve as they believed intelligence was malleable, but the students would also choose to take higher difficulty of math courses.

Self-Efficacy

Bandura (1977) defined self-efficacy as a person's beliefs about his or her ability to succeed in a specific task. Increased perceived self-efficacy has been shown to increase an individual's willingness to choose difficult tasks, to persevere through obstacles, and have more effective use of analytic thinking (Bandura, 1977; Bandura & Wood, 1989). Low perceived self-

efficacy has been linked to low effort, avoidance of challenging tasks, and the use of poor coping behaviors (Bandura, 1977). Any type of failure leads to self-blaming and aversion to any additional challenge to avoid feeling weak. Bandura and Wood (1989) found a person's perceived self-efficacy influenced his or her personal goals both directly and indirectly. Direct influences included the choice of pursuits and the amount of effort in current situations and indirect influences include impacting future goal setting and goal attainment (Bandura & Wood, 1989; van Rooij, Jansen, & van de Grift, 2017). Bandura (1993) also found that a student's perceived efficacy impacted one's ability to regulate self-learning and motivation, consider future aspirations, master academic topics, and determine academic performance. Bandura and Wood's (1989) study found that students who believe their situation is out of their own control exhibit low self-efficacy, giving up on a task regardless of the task's difficulty level. This shows that students' perceived controllability affects self-efficacy as well. Students that have a sense of controllability produce positive effects on self-efficiency and academic accomplishments (Bandura, 1993; Bandura & Wood, 1989).

So, how does one develop self-efficacy? Bandura (2000) states that the best indicator and pivotal aspect of motivation and learning is the core belief that one has the power to accomplish desired goals, positive self-efficacy. It is also a crucial predictor of academic success for student achievement and retention in higher education (van Rooij et al., 2017). To foster self-efficacy in students, it is important to set up situations of success that include varying difficulty. Bandura (2000) said that it is not enough to gain self-efficacy through easy success, but more important to graduate success attainment through experiences that include perseverant effort and learning through mistakes. By having experiences that require effort, students realize that through hard work, success is attainable. One study found that a student's need for

cognition, engagement, and enjoyment of learning, and interest in a subject were found to be key indicators of self-efficacy (van Rooij et al., 2017). Other methods of developing student self-efficacy include social modeling and social persuasion. Students that have examples of pursuing challenges that lead to success and goal attainment will then adopt the belief that their own goals can be reached (Bandura, 2000). Social persuasion consists of building success through conveying faith in an individual to reach the desired goal and intentionally creating situations that are attainable, avoiding tasks that are likely to fail for an individual (Bandura, 2000). This includes creating differentiated situations for different individuals depending on personal learning levels. Lastly, efficacy beliefs are encouraged through the reduction of anxiety, depression, and physical stressors. This again is an individual characteristic that may be triggered by past experiences and background. Anything that can be done to relieve these stressors can increase a student's self-efficacy (Bandura, 2000).

Students that participate in rigorous coursework, such as Honors classes, typically prescribe to a higher perception of self-efficacy. Choosing to take a course with higher difficulty shows personal motivation and interest, a sense of academic accomplishment, and goals that include college preparation. A high perception of self-efficacy has been shown to influence college readiness, college perseverance, and degree attainment (Cromwell et al., 2013; Giani et al., 2014, van Rooij et al., 2017). Pajares' and Miller's (1994) study found that self-efficacy was a predictor of mathematics performance and that males had higher self-efficacy than females. However, van Rooij et al. (2017) found no evidence of gender differences involving self-efficacy. Other studies have shown women pursuing male-dominated careers, such as math and science, have been shown to have a higher self-efficacy because these individuals must persevere and have the resiliency to overcome career stereotypes (Bussey & Bandura, 1999; Zeldin &

Pajares, 2000). It is evident from these studies that self-efficacy is a dynamic concept (Bandura, 1977, 1993; Bandura & Wood, 1989; Bussey & Bandura, 1999). Gore (2006) found that students' self-efficacy was a very weak predictor of college success as they began college, in their first semester, but became a significant predictor of success after the end of the first semester. This study suggests a change occurred through the first semester of the college experience that created new perceptions of self-efficacy. In contrast, it is also worthy to note that Gentry and Owen's (2006) research study found that Honors and AP students thought their courses to be more rewarding through the challenge, attributing success to both hard work and ability, but their self-efficacy score was the same as students of Non-Honors courses. Due to the complexities of self-efficacy theory, it may not explain all the differences in college readiness of students; however, its foundations clearly set the stage for the current research.

Gender Theory

Bem's (1981) gender schema theory suggests that gender roles are adopted by young children because of cultural and societal norms classifying specific attributes or concepts as being either masculine or feminine. Sex-typing drives students to think of certain interests, subjects, and occupations as gender specific, masculine or feminine (Bem, 1981). She posited that as students are subjected to sex-typing, they evaluate their self in relation to the gender schema and if it does not match with societal norms then self-esteem can be damaged. The gender schema also can cause a student to conform behaviors of decision making, such as which courses to enroll, to culture's stereotypes of male and female (Bem, 1981). The schema can have lasting effects and influence cognitive processing through a lifetime (Bussey & Bandura, 1999; Starr & Zurbriggen, 2017). Bem's gender schema theory has been used as a foundational

framework for over 34 years and continues to play an important role in gender research (Starr &
Zurbriggen, 2017).

Gender has been a focus or factor in many studies throughout the years, and these
stereotypes can have a significant impact on lives, especially for women (Starr & Zurbriggen,
2017). Many studies have focused on the disparities of women in the fields of math and science
(Casey et al., 1997; Cheryan, 2012; Cheryan, Drury, & Vichayapai, 2013; Combs et al., 2010;
Gottfried, Owens, Williams, Kim, & Musto, 2017; Niederle & Vesterlund, 2010; Reilly,
Neumann, & Andrews, 2015). The subjects of math and science, and occupations that utilize
those topics, have been linked to a masculine sex-type which may hinder females from pursuing
higher-level courses because of their association with a non-traditional role (Bussey & Bandura,
199; Cheryan, 2012). The gender gap has been well documented but has decreased in recent
years due to efforts of changing the stereotype of the subjects and a renewed focus on promoting
science, technology, engineering, and math (STEM) in schools but has not disappeared
especially in high achievers (Casey et al., 1997; Cheryan, 2012; Reilly et al., 2015). Reilly et al.
(2015) suggested that the disparity between genders in the high achievers may be related to sex-
typing that occurs during early adolescence favoring males in the rigors of math and science and
thoughts that males have higher mathematical intelligence than females. These types of issues
can deter females from pursuing STEM-related courses and fields of study in college (Reilly et
al., 2015). Casad et al. (2017) stated,

> Research has documented how environments dominated by males can be threatening to
> women and girls and can elicit stigma and stereotype threat, which can lower their sense
> of belonging, increase feelings of exclusion and isolation, and lead to disengagement

from the domain. [This] can discourage girls and women from pursuing STEM education

and careers. (p. 513)

The gender gap has also been a topic of interest in college readiness research. Several

current studies have shown that more females are entering college than males and females have

better grades; yet, the number of women in the STEM fields is still below that of men (Cheryan,

2012; Combs et al., 2010; Reilly et al., 2015). In the case of computer science, the gender gap is

actually growing instead of declining (Cheryan, 2012; Cheryan et al., 2013). There are mixed

reports regarding college entrance exams, such as SAT, PSAT/NMSQT, and ACT, about gender

discrepancies. While most studies have found the gender gap has decreased over time, some

studies show a gender discrepancy on standardized tests and others support only insignificant

differences or no differences at all (Combs et al., 2010; Houser & An, 2015; Long et al., 2009;

Reilly et al., 2015).

This study will research the differences between college readiness and the rigor of an

Algebra 1 course taken by students in a private school setting. The foundational theories and

existing research involving incremental intelligence, self-efficacy, and gender schema theory will

help guide the current research and its implications.

Related Literature

History of College Readiness

College readiness has been a focus for many years and a priority for economic success

(Wyatt et al., 2014). To encourage students to continue into higher education, the College Board

Entrance Examination Organization (College Board, 2018) was formed to simplify the college

admissions process in early 1900. Several college entrance exams have been created to help

college administrators evaluate student college readiness including the SAT and the ACT test.

Most colleges today use a combination of high school GPA, college entrance exams, and the level of course rigor taken by students (Camara, 2013; Cromwell et al., 2013; Hein et al., 2013; Sciarra, 2010; Wiley, Wyatt, & Camara, 2011).

On the state level, several initiatives have been put in place to encourage secondary students to become focused on going to college for the best financial future and to spur on the American dream. In 1983, America saw a surge in the concentration of educational standards and a push for advances in college readiness with President Reagan's *A Nation at Risk* citing the declining state of education based on standardized test score (Barnes & Slate, 2013; Sciarra, 2010). In 2001, the No Child Left Behind Act (NCLB) had many states adopting standards for public schools and developing high stakes tests to show that students were learning key knowledge content. However, these tests were not well-aligned with items needed for post-secondary success (Barnes & Slate, 2013; Conley, 2007). This led to a nation which was not ready for college. According to the National Center for Educational Statistics (NCES) of 2004, 40% of the students enrolled in college had to take at least one remedial course which dramatically increased their cost of college and decreased the chance of graduation. In fact, only 17% of students required to take a remedial reading course would go on to receive a bachelor's degree (NCES, 2004). In 2011, 10 years after NCLB, ACT reported that only 25% of high school students who took the ACT college entrance exam were considered college-ready on all benchmarks (Barnes & Slate, 2013).

There has been a renewed interest at the national level to create students who were college and career ready where policies have been enacted for a direct impact on students, teachers, and society (U.S. Department of Education, 2010). In 2010, President Barrack Obama emphasized the need for students to graduate high school completely college-ready, without the

need for remediation (Barnes & Slate, 2013). The Common Core State Standards were created

to give a unifying system of education, for all states that adopt them, and have a way to assess

college and career readiness on a national level (Camara, 2013). According to Achieve, Inc.

(2017),

> By 2020, 65 percent of all jobs, and 92 percent of all traditional STEM jobs, will require
>
> postsecondary education and training. College- and career-ready graduates should be
>
> able to enter and succeed in entry-level postsecondary courses without the need for
>
> remediation. (p. 1)

However, Edmunds, Bernstein, Unlu, Glennie, Willse, Smith, and Arshavsky (2012) stated at

least one-third of high school graduates were unqualified or marginally qualified to attend

college, and the NAEP (2015) report for 2015 showed only 37% of 12th-grade students were

academically prepared for college in reading and mathematics. Furthermore, Achieve, Inc.

(2014) stated in a report, "Too many recent high school graduates report gaps in their

preparedness for college and work after high school" (p. 3). Their survey found that 47% of

college students felt they had gaps in their own high school education which led to not being

prepared for college (Achieve, Inc., 2014).

Defining College Readiness

There are many skills needed to be successful in college and persist in gaining a college

degree. Unfortunately, just earning a high school diploma does not mean that a student is

college-ready (Heller, 2012). Conley (2007) defined college readiness as the level of preparation

a student needs in order to enroll and be able to take the next course in the sequence, without

remediation, in a credit-bearing general education course at a postsecondary institution that

offers a baccalaureate degree or transfer to a baccalaureate program. To meet this definition,

Conley (2007) described several facets necessary to achieve college readiness: habits of mind, key content, academic behaviors, and contextual skills and awareness. These facets are not mutually exclusive and may interact with one another.

Conley (2007) stated the foundational key is the habits of mind facet. A well-prepared college student utilizes the habits which allow for learning in any discipline, and are ready for the intellectual demands of post-secondary education (Conley, 2003, 2007). The habits of mind are the most important because they incorporate ways of thinking instead of just content areas. These habits have been shown to be closely related to college success and include intellectual openness, inquisitiveness, analysis, reasoning, argumentation, and proof, interpretation, precision and accuracy, and problem-solving (Conley, 2007). These core habits can be utilized in any subject or situation, both in college and career situations. These habits are also not typically found on a content knowledge-based multiple-choice test.

College Readiness Indicators

There are specific skills that are associated with college readiness which can be evaluated throughout a student's schooling as early as elementary school. Some of the earliest indicators of college readiness include reading by the third grade, having a high classroom participation rate, a high attention span and social competence (Hein et al., 2013). Once in middle school, students' choices of rigorous coursework come into play. Hein et al. (2013) shared that students who take rigorous coursework beginning in middle school, specifically Algebra 1 in the eighth grade, and meeting the benchmarks for math indicate being on track for college-readiness. High school factors give the best indication of college readiness as the time is nearing for students to enter post-secondary education. Martinez and Klopott (2005) stated that "effective practices in high school restructuring aimed at increasing student achievement and equitable outcomes shows

that these practices are consistent with predictors for college enrollment and success" (p. 36).

Factors of college readiness in high school include missing no more than 10% of school days,

maintaining a 3.0 high school GPA, passing college entrance exams such as PSAT/NMSQT and

SAT, completing rigorous coursework including Honors, AP, or dual-enrollment courses, taking

math courses beyond Algebra 2, and meeting with academic advisors or guidance counselors for

college planning (Barnes & Slate, 2013; Camara, 2013; Conley, 2007; Conley & McGaughy,

2012; Cromwell et al., 2013; Hein et al., 2013; Kalinski & Godfrey, 2014; Sciarra, 2010; Wiley

et al., 2010). Hoffman, Vargas, and Santos (2009) reported that one state "invested in early

education, raised high school graduation standards, and increased K–12 accountability" (p. 51) to

help meet the standards of college readiness for their students.

Measuring College Readiness

While no one test can perfectly predict the college readiness of an individual student,

college entrance examinations have been created to assess readiness skills and have shown

predictability of both college GPA and degree completion (Camara, 2013; Wiley et al., 2011).

Because these standardized tests are used nationally, they do not have the bias of grade inflation,

specific state or district knowledge, and curriculum standards (Conley, 2007; Kalinski &

Godfrey, 2014; Milewski & Sawtell, 2006). Instead, these exams utilize some specific

knowledge content necessary to be successful in first-year college courses and test critical

thinking, analysis, and problem-solving strategies along with time management skills (ACT,

2011; College Board, 2018). All of these areas are described as factors of college readiness

(Conley, 2007; Conley & McGaughy, 2012). Many research studies have relied on college

entrance exams as a measure of college readiness as the scores are relatively easy to obtain and

are free from GPA ambiguity (Milewski & Sawtell, 2006). The exam scores are typically scored

by subject (e.g., mathematics and reading), and then a total composite score is given. The composite and subscores have benchmarks associated with college readiness depending on the school and field to which a student is applying. College Board and ACT also have benchmark scores associated with overall college readiness that colleges use as part of their admissions process (ACT, 2011; Wyatt et al., 2014).

       College Board and SAT. College Board was created in 1900 as a not-for-profit membership association that connects students to college opportunity and success through college admissions testing and guidance in financial aid and college preparation (Milewski & Sawtell, 2006). The College Board exists to expand access to higher education and serve the millions of students, parents, high schools, and colleges through its services in college readiness such as its most notable programs, SAT®, PSAT/NMSQT®, and AP® (Milewski & Sawtell, 2006; Proctor et al., 2010; Wyatt et al., 2014). The SAT exam measures a student's college readiness as a composite score combining subscores in the areas of mathematics and verbal reasoning and writing skills (Milewski & Sawtell, 2006; Proctor et al., 2010; Wyatt et al., 2014). SAT exams are typically taken late in the junior year or early senior year with the scores being widely used in college admission decisions (Wiley et al., 2010; Wyatt et al., 2014). However, it is important for students to understand if they are on track for college readiness before the end of their high school experience. The PSAT/NMSQT has been shown to be an excellent measure of early college readiness. Taking the PSAT/NMSQT in the 10th and 11th grade, along with the SAT later, has been shown to significantly increase the probability of college readiness, persistence in college, and degree attainment within four years (Wyatt et al., 2014).

       PSAT/NMSQT. College Board created the PSAT/NMSQT to be used as an early indicator of college readiness for students mainly in the 10th and 11th grade, although some

students take it earlier (Milewski & Sawtell, 2006). The PSAT/NMSQT shares the statistical and

content specifications of the SAT with slightly lower difficulty, particularly in mathematics as it

does not include content from a third-year college preparatory math course (Milewski & Sawtell,

2006). The PSAT/NMSQT quantifies an early measure of a student's college readiness as a

composite score which is a sum of the reading and mathematics subscales (Wyatt et al., 2014).

The College Board (2017) explains the PSAT/NMSQT scoring process follows:

> To calculate section scores, we first compute the student's raw score—the number of
>
> questions correctly answered—for each section. Nothing is deducted for incorrect
>
> answers or for unanswered questions. Next, we convert each of the raw section scores to
>
> a scaled score of 160 to 760. This conversion process adjusts for slight differences in
>
> difficulty among versions of the test and provides a score that is consistent across
>
> different versions. The scaled scores are the scores provided on score reports. (p. 1)

The PSAT/NMSQT has been used to identify students who need early intervention supports and

those who are ready for more challenging coursework (College Board, 2017; Milewski &

Sawtell, 2006; Wyatt et al., 2014). Among other indicators, the PSAT/NMSQT test has been

used to identify students that are ready for higher-level courses such as Honors, AP® courses,

IB, and dual enrollment or early college programs (Ewing & Wyatt, 2017; Geiser & Santelices,

2004; Richardson, Gonzalez, Castillo, & Carman, 2016). The 10th and 11th graders taking the

PSAT/NMSQT get a strong and reliable early indicator of college readiness (Proctor et al.,

2010). Both the SAT and PSAT/NMSQT benchmarks represent college readiness for students

with the minimum scores predicting a 65% chance of having a C average in the first year of

college (Wyatt et al., 2014). Students that meet the PSAT/NMSQT and SAT college readiness

benchmarks have a 90% enrollment in four-year college institutions and, of those, almost 60% rate of degree attainment within four years (Wyatt et al., 2014).

Several studies have used PSAT/NMSQT test scores as a benchmark to evaluate college readiness, the academic performance of students, and to evaluate the validity of other standardized tests. College Board has done continuous studies as to the predictive nature of the PSAT/NMSQT to SAT scores and to academic performance in higher education including first-year college GPA, degree attainment, and AP ® Exam success (Milewski & Sawtell, 2006; Richardson et al., 2016). There have been other studies that use the PSAT/NMSQT as the benchmark to compare the validity of new standardized tests and measurements, such as the Readistep ® and Accuplacer ® tests, the Common Core Standards, state end of course testing, and to evaluate student college readiness (Camara, 2013; Ewing, 2007; Kim et al., 2014; McKelvey, 2006).

Studies have used the PSAT/NMSQT test as an instrument of study and comparison because of its extensive use in college admissions and the general knowledge that it is a valid and reliable instrument. McKelvey (2006) conducted her study on the relationship between the Virginia Standards of Learning (VA SOL) End-of-Course tests for Reading and Writing and the PSAT/NMSQT verbal and writing scores. Her study used both linear and logistic regression analysis and found there was a significant predictive relationship for student scores on the PSAT/NMSQT and the VA SOLs (McKelvey, 2006). Ewing (2007) began her studies into the predictive nature of the PSAT/NMSQT to AP ® exam performance with her dissertation in 2007. She utilized multilevel modeling to determine the relationship between the PSAT/NMSQT scores and AP exam performance and looked for any differences in gender scores. Her study found that the PSAT/NMSQT scores did have a predictive pattern for those

with AP exam success and further that each of the subscores held predictive accuracy, not just the composite score (Ewing, 2007). She also found the predictive accuracy improved for the math AP exams such as Physics E & M, Calculus BC. The gender fairness indicator based on the average over- and under-prediction indicator was small suggesting that there was no bias based on gender; however, Ewing (2007) did mention this as a specific need for future research. Ewing has continued her research into this area of predictive accuracy for the AP exam performance in her current research with similar findings (Ewing & Wyatt, 2017; Patterson & Ewing, 2013; Zhang, Patel, Ewing, 2014).

Economic Impact of College Readiness

There is a tremendous economic impact for those with a college degree. In 2007, a male college-educated student earned 79% more income than a student who only obtained a high school diploma and a female college-educated student earned 92% more income (Danziger & Ratner, 2010). Students that are on-track for college readiness early, as indicated by PSAT/NMSQT scores, have been shown to attend four-year colleges 89% of the time with 58% of those students graduating in four years (Wyatt et al., 2014). Yet, of first-year college students entering college in 2001, only 56% of them had earned a degree six years later (Wiley et al., 2011) and only about one-third to one-half of high school graduates were prepared to enter college (Heller, 2017).

The length of time it takes to earn a degree impacts the success and earnings potential for students due to delay in starting a career and the loan amount needed to complete a degree. Adelman (2006) found students who had to take even one remedial course in college were significantly less likely than their peers to complete their degree. In contrast, students who engage in rigorous mathematics courses have been positively correlated with entering college

and have a higher positive correlation with attaining a four-year degree which leads to higher income potential (Camara, 2013; Gianni et al., 2014; Hein et al., 2013; Kaliski & Godfrey, 2014). This is especially true for minority and female students (Bancroft, Bratter, & Rowley, 2017). In 2016, the average starting salary for students earning bachelor's degrees was $50,359 (National Association of Colleges and Employers [NACE], 2017). The NACE (2017) rated students with degrees in computer science, engineering, and mathematics as the top three average starting salaries in 2016. These occupations heavily incorporate the study of mathematics for success. Yet, even with the financial benefits of majoring in STEM careers, such as math and science, there have been a lack of students pursuing these careers, especially women (Casad et al., 2017; Gottfried et al., 2017; Michael & Alsup, 2016; Reilly et al., 2015).

Gender and College Readiness

Gender differences in students' college readiness have been an area of interest as well. In the 1980s and 1990s, research found that male students were receiving higher college entrance exam scores mainly due to higher mathematics sub-tests (Harris & Carlton, 1993). In 1993, further research indicated that males showed an interest in applied mathematical problems such as real-life word problems and females tended to do better with more abstract Algebra computations narrowly closing the gap (Harris & Carlton, 1993). Efforts were made to analyze the college entrance exams for bias and increase female student involvement in higher science, technology, engineering, and mathematics courses. Casey et al.'s (1997) study showed that there was only a slight advantage in males' mathematics college entrance exams scores overall, but that a larger discrepancy was found as the highest achievers scores were analyzed. The reasoning for the discrepancy was better spatial awareness skills for males versus females necessary in problem-solving strategies (Casey et al., 1997).

Reilly et al. (2015) also showed the largest gender achievement differences in math and science were found only in the high achievers favoring males. Data from the 2003 TIMSS showed very little difference in math college readiness between genders (Else-Quest et al., 2010). In 2010, a study found that male students had only slightly higher SAT scores, an average of one point but larger standard deviation, showing increased college readiness over female students (Combs et al., 2010). Nankervis (2013) found that a slightly higher increase in male 2010 PSAT scores also gives males an advantage in the National Merit Scholarship competition. However, other studies show only small or insignificant differences in male and female scores on a college readiness tests (Houser & An, 2015; Long et al., 2009; Long, Conger, & Iatarola, 2012; Reilly et al., 2015). This change could be due to the increase of females participating in college preparatory courses in recent years, such as higher mathematics, closing the achievement gender gap (Long et al., 2009). The increased participation in higher-level mathematics courses by females was also evident because 48% of undergraduate mathematics degrees were being earned by females; however, females still fall behind males in applied math and science degrees such as computer science, physics, and engineering (Cheryon, 2012; Houser & An, 2015). The NAEP (2009) published results of their high school transcript study showing that in 2009 12th-grade males and females earned the same number of math credits and females earned slightly more credits in English courses. It is worthy to note that the rigor of math courses taken by high school females was about the same as that of males with most of the courses having a higher percentage of females earning credits than males (NAEP, 2009). The NAEP (2015) report showed a slight increase in proficiency in math for 12th-grade males over females but a larger increase for female proficiency over males in the reading assessment.

Academic Rigor

One of the most significant indicators of college readiness is the concept of academic rigor (Camara, 2013; Cromwell et al, 2013; Hein et al., 2013; Martinez & Klopott, 2005). Students have choices in not only the courses they choose to take in secondary school, but also the level of rigor associated with a specific course in the way of taking Honors, Non-Honors, AP, or a dual-enrollment section. Not all courses have these distinctions, and the courses available vary by school. However, taking the most advanced courses in high school has been linked to higher first-year college GPA, being placed in non-remedial credit baring courses entering college, persisting in post-secondary education, and obtaining a baccalaureate college degree within four years (Cromwell et al., 2013; Giani et al., 2014; Hein et al., 2013; Milewski & Sawtell, 2006; Wyatt et al., 2011). Conley (2007) suggested specific math and English course selection in middle school could also play a part in getting students college-ready.

Academic rigor is defined as exposing students to a rich knowledge core that is organized around the mastery of major concepts which provide students with regular opportunities to pose and solve problems, formulate hypotheses, justify their reasoning, construct explanations, and test their own understanding (Boston & Wolf, 2006). Studies show participating in rigorous courses, such as Honors, pre-AP, and AP has a significant effect on academic performance as measured by standardized testing such as the PSAT/NMSQT and end-of-course testing (Bancroft et al., 2017). Studies have also shown a strong positive correlation for students who take rigorous math curriculum and college readiness over those who do not regardless of gender, ethnicity, and socioeconomic status (Bancroft et al., 2017; Conley, 2007; Cromwell et al., 2013; Hein et al., 2013; Houser & An, 2015; Sciarra, 2010; Wyatt et al., 2011). Studies suggest taking rigorous coursework could be even more important for the college readiness of females, minority

students, and those with lower SES (Bancroft et al., 2017; Lee, 2012; Long et al., 2009). Long et al. (2012) made the following statement regarding the importance of researching specific courses, curriculum, and rigor that benefit students, improve education, and enhance economic impact:

> The existing literature offers limited investigation into the relative performance returns to rigorous courses in different subjects and the variation in course-taking effects across subgroups of students and across high schools with different characteristics. As a result, we know very little about which courses across the high school curriculum most improve education and labor market prospects, whether all students benefit equally from their coursework, and whether the benefits of rigorous courses depend upon the characteristics of the high schools in which they are taken. (p. 283)

Long et al.'s (2012) study showed that students taking even one rigorous course early in high school significantly increased their 10th-grade math scores. Taking rigorous courses within the first two years of high school also increased the probability of on-time graduation and attending a four-year college for these students by 10% (Long et al., 2012). Long et al. (2012) also found a rather interesting side effect of taking rigorous courses in high school:

> Furthermore, students who enroll in college get additional value from their rigorous high school courses; college students who took a rigorous course in nearly any subject earned more college credits and higher college grade point averages and were more likely to earn a bachelor's degree. (p. 316)

Proctor et al. (2010) understood the importance of rigor in the high school curriculum when creating their Academic Readiness Indicator (ARI) which helps determine a student's early college readiness. They looked at a variety of indicators for college readiness and chose to

include the composite PSAT/NMSQT score and rigorous course taking as main components for the ARI to give college administrators a way to score college readiness along with high school GPA and other college entrance exam scores such as SAT and ACT (Proctor et al., 2010). McCormick and Lucas (2011) stated, "A demanding school curriculum immersed in a culture that not only emphasizes content knowledge, but also recognizes the importance of developing key cognitive strategies…prepares students for success both in post-secondary education and in the workplace" (p. 22).

Mathematics Rigor as a College Readiness Indicator

Conley (2007) stated the college-ready student has a thorough foundation in Algebra and can apply the conceptual understandings to solve problems, interpret solutions, and determine the reasonableness of an answer. These skills will be necessary for many types of occupations that involve mathematics such as engineering and science, but also in areas such as business and marketing. Many studies have shown that math achievement and taking rigorous math courses are not only a predictor for how a student will fare in college math, but as an indicator of overall college readiness (Casey et al., 1997; Hein et al., 2013; Lee, 2012; McCormick & Lucas, 2011; Sciarra, 2010). In fact, college math professors believe that a solid understanding of Algebra is the foundation for all other higher-level math and science courses (Conley, 2003). This suggests Algebra 1 is a key foundational course which needs to be researched for college readiness potential. Abraham, Slate, Saxon, and Barnes (2014) shared that students whose math scores met college readiness benchmarks were much better prepared for not only math courses but all STEM courses such as engineering and all sciences, including biology which is not typically thought of as a mathematical science.

The rigor of math courses taken also has predictive power for college readiness. Adelman (2006) found that curriculum intensity in mathematics was the greatest indicator of not only college entrance but of obtaining a college degree. Specifically, completing advanced mathematics courses above Algebra 2, like trigonometry, pre-calculus, and calculus, had significant predictive power regarding degree attainment (Adelman, 2006). Sciarra (2010) found that taking intensive math courses can also significantly decrease the effects of other factors such as gender, ethnicity, and SES on college success. McCormick and Lucas (2011) stated, "As requirements for post-secondary education and qualifications for the workforce merge, college readiness in mathematics is a significant factor in job opportunities and career choices" (p. 1).

Course designations that increase the rigor of math course taken include Honors, AP, IB, and dual enrollment (Wyatt et al., 2011). These course designations increase the rigor of general math courses such as Algebra 1, Geometry, or Algebra 2, Precalculus, and Calculus. There are typically higher standards and expectations set for these courses and pre-requisites that must be met and sustained to be considered for the course (Casad et al., 2017). These rigorous designations have also been shown to be indicators of college readiness (Camara, 2013; Cromwell et al., 2013; Hein et al., 2013; Wyatt et al., 2011); however, there are some that say just merely participating in the rigorous courses does not predict college readiness (Geiser & Santelices, 2004). Studying the effects of Algebra 1 course rigor on college readiness will allow for more data analysis on these conflicting studies.

Studies show that curriculum choices need to be made early in a student's secondary career to get on a college preparatory track and have the best chance for success (Cromwell et al., 2013; Kim et al., 2014; Hein et al., 2013). Casad et al.'s (2017) study included gender stereotype threat and differences for middle school females enrolled in Honors or Non-Honors

(called standard or regular) math classes. They found that females enrolled in the Honors course had a more positive attitude toward mathematics and were more engaged than those enrolled in the Non-Honors math course in middle school. The explanation for the difference between the courses was that females in Honors courses felt the environment was more secure, and because they were high achievers training for pre-college track, gender identity threat was neutralized (Casad et al., 2017). Casad et al. (2017) suggested further research was needed to explore gender differences among adolescents in Honors compared to standard math courses.

Private Schooling

Most of the current education research is conducted using data and information gathered from public schools. According to the NCES for 2015, approximately 90% of students attend public schools in the United States, which consist of local district schools, magnet schools, and charter schools, or any school that receives public funds for operation. Private schools are defined as any school that is not supported primarily by public funds which provides classroom instruction for one or more of grades K–12 and has one or more teachers (Broughman et al., 2017) and represent approximately 10% of the nation's students. Private schools can be religious or non-religious and are typically tuition-based. Some of the categories of private schools include religious schools such as Catholic schools and protestant schools, and non-religious private or independent schools (Carpenter, Keith, & Catt, 2016). Catholic schools are the largest sector of private schools and have typically been used as a comparison with public schools (Berger & Winters, 2016). The schools are independent of state standards and each other so their populations can be quite different and harder to research. It is vital that current education research represent this overlooked population sector.

Private school research. In 1981, Coleman discussed his research analysis of testing

data confirming private school students have higher academic results than public schools. When confronted about the possibility the results were skewed due to the selection process by the nature of private schooling, Coleman (1981) reexamined his results and found that approximately half of the difference could be a result of selection. However, the other half of the difference remained. In fact, for mathematics, more than half of the difference remained to suggest private schooling did contribute to higher academic achievement versus public schooling. The analysis also showed that learning rates were higher for private school students versus public school (Coleman, 1981). Of course, this research was not well received. Many researchers completed their own studies using the testing data trying to show that the analysis was faulty due to the varying characteristics of the students which could not be attributed to the data itself, such as parental involvement, motivation of the students, or that the research reflected inadequate controls of the traits analyzed (Murnane, 1984; Neal, 1998). Research continued with analysis of the National Education Longitudinal Study of 1988 which found private school students still had an academic advantage (Carbonaro & Covay, 2010). Other researchers used the data to find other interesting effects from private schooling such as graduation rates, college entrance rates, and college degree attainment increased for Whites, Blacks, and Hispanics (Neal, 1998). Fueled by political topics such as tax credits and school vouchers, the debate continued back and forth with multiple researchers analyzing the data in different ways and Coleman responding (Murnane, 1984).

In 2006, Lubienski and Lubienski re-sparked the debate using newer data from the 2000 NAEP math assessment to run analysis on the differences of public and private school students utilizing multiple background traits. The Lubienski and Lubienski (2006) study analyzed the new data for the "Private School Effect" by creating a new SES variable that they claimed would

offer better insight into the performance of mathematics scores between public and private schools. These variables included not only Title I and lunch assistance but self-reported items such as academic resources at home, such as computer and internet access, reading materials, and the amount education was discussed at home. Their findings showed when students were categorized into four quartiles of SES and mean math scores were compared of public and private school students within the quartiles, public schools slightly outscored private schools by 10 or fewer points per grade analyzed (Lubienski & Lubienski, 2006). Their conclusion was that even though private school scores as a whole outscore the public schools when further analysis is applied, the academic measures of public schools are higher than the private school sector. In 2006, NCES published a similar report using the 2003 NAEP testing data which again showed private schools outperforming public schools until adjusted for specific student characteristics. Once adjusted, the private school advantage was whittled away with only slight gains or on par with public schools. However, Peterson and Llaudet (2007) suggested that the measure of student characteristics was flawed, and the private schools retained their advantage when they analyzed the data with different characteristic measures. Peterson and Llaudet (2007) stated the NCES study repeatedly used classification bias because the characteristics used to adjust the data were not consistent for both groups. They claimed that the NCES undercounted the disadvantage in the private schools and overcounted it in the public sector when it came to participants of federal programs such as Title I, free and reduced lunch, limited-English proficient and special education (Peterson & Llaudet, 2007). Wolf (2014) also stated the Lubienski and Lubienski (2006) report lacks credibility due to a narrow definition of school performance, testing that aligns more closely to public schools, the use of the control variables that are measured differently across the school sectors, and the improper handling of students

who switch sectors.

The debate continues in current research as school choice, vouchers, and education tax credits continue to be in the front of political topics. Carbonaro and Covay (2010) noted the standards-based reforms have closed the achievement gaps between the public and private school sectors; however, private school students were shown to take more advanced mathematics courses than public school students which accounted for most of the difference in the achievement gap. The achievement gain increases in private school students in 10th to 12th grade over public schools mostly due to the rigorous math courses taken by the private school students. Other current research has focused more on other advantages private school students gain relating to adult life. Jerrim et al. (2016) found that while some of the benefits of entering college, academic achievement, and post schooling work from private school students was attributed to higher family income or secondary school achievement, a large statistically significant percentage cannot be explained by these factors. This suggests that a private school difference contributes to these advantages.

Studies specific to private schools. The current study is unique in the fact that it focused on a single private school setting. While there is a tremendous amount of literature focused on public education, there is little being researched on private schooling. A number of studies have noticed the void and suggest further research be conducted on special education sectors such as private schools (Camara, 2013; Duggan, 2009; Hein et al., 2013). According to Dalton, Ingles, Downing, and Bozick (2007) private school students are more likely to complete calculus, chemistry, and physics than public high school graduates; yet, many national statistics show that public school and private schools show no significant difference in achievement levels with some private school segments showing lower levels after factor adjustments (Braun, Jenkins, &

Grigg, 2006). There are mixed findings on the achievement levels of private school students versus public school because of the adjustment for SES (Jerrim et al., 2015). Some suggest that affluence and family background help increase private school students' achievement even before they reach school age which gives them an immediate advantage over the average public school student (Jerrim et al., 2015; Lubienski & Lubienski, 2006). However, some researchers have disputed these claims and suggest the criteria used to make adjustments was faulty in the studies (Wolf, 2014). In 2011, Lefebvre, Merrigan, and Verstraete found that private schooling in Quebec improved student mathematics achievement ranging from 5 to 10 percentile ranks which were similar to results in U.S. Catholic schools. Jerrim et al.'s (2015) study found that after controlling for family background and higher academic achievement in secondary school, private school students still manage to have significantly higher differences in post-secondary outcomes such as entering college and attaining a degree. Berger and Winter (2016) found that for females there was a significant positive relationship for higher earnings. More research needs to be done regarding private schooling in order to replicate findings from public schools and get a better picture of the entire student population including the private school sector.

<div align="center">**Summary**</div>

The literature review shows a plethora of findings on measuring college readiness and how a student's math courses play an integral part in an individual's college readiness, persistence, and degree attainment. However, there are conflicting reports involving whether just participating in advanced mathematics or achieving certain benchmarks in the courses impacts college outcomes. There also is a lack of literature involving private school data due to the smaller sample sizes, and the literature that does exist seems to be inconsistent in its findings. The current study addressed differences in participating in an early rigorous foundational

mathematics course and college readiness in a private school. The study adds to the lack of literature for private schooling and helps gain an understanding of conflicting reports to determine if the school setting plays a part in the results. The current study also fills the gap in the emerging literature regarding early indicators of college readiness.

CHAPTER THREE: METHODS

Overview

College readiness has been a focus of educational research since the White House issued

a call for students to be better equipped for college and career upon high school graduation (U.S.

Department of Education, 2010). The current study investigated the differences between college

readiness and Algebra 1 course type of male and female students enrolled in a private high

school located in southwestern Virginia. Chapter Three discusses the design and methodology of

the research study. The chapter also addresses the design structure, research questions,

participants, procedures, instrumentation, and data analysis used in the study.

Design

This research study used a quantitative causal-comparative design. The study was

considered causal-comparative as the observed variations in the relationships between the

independent and dependent variables were naturally occurring without manipulation from the

researcher (Gall, Gall, & Borg, 2007). The design was appropriate because this study was non-

experimental where the researcher was interested in the possible cause and effect relationship of

certain groups (Gall et al., 2007). In causal-comparative designs, there are multiple independent

variables measured in categories which are either present or absent in the groups, and the

independent variable is not manipulated by the researcher (Creswell, 2015; Fraenkel, Wallen, &

Hyun, 2012; Gall et al., 2007). It is necessary to be tentative about the claim of causality in this

type of study as alternative interpretations are possible (Creswell, 2015; Gall et al., 2007). The

study was ex post facto because the data used to test the hypothesis had already occurred (Gall et

al., 2007). The dependent variable in this study was college readiness as measured by the

mathematics portion of the Preliminary SAT/National Merit Scholarship Qualifying Test

(PSAT/NMSQT). There were two independent variables for this study. The first independent variable was the type of Algebra 1 course taken and contained two levels: Honors and Non-Honors. The second independent variable was the gender of the student. Multiple studies in this research area have examined gender differences between participants justifying continued comparison in this research study (Combs et al., 2010; Long et al., 2009; Michael & Alsup, 2016; Reilly et al., 2015).

College readiness is defined as the level of preparation a student needs in order to enroll and be able to take the next course in the sequence, without remediation, in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program (Conley, 2007). The best measure of college readiness has been debated for some time to determine whether one assessment score or multiple criteria is a true indication of student preparedness (Maruyuma, 2012). While one test score may not provide the whole picture of a student's performance, national standardized college entrance exams such as SAT, ACT, and PSAT/NMSQT have been used as one measure of college readiness for many years (Camara, 2013; Cromwell et al., 2013; Wyatt et al., 2011). These national college entrance exams are not influenced by locality bias and provide student comparisons using the same assessment. In fact, colleges use these assessments as benchmarks to validate preparedness and exempt students from remedial courses for college mathematics and English upon enrollment (Camara, 2013).

For this study, college readiness was measured by the mathematics portion of the PSAT/NMSQT scores. There were two course type designation levels for Algebra 1 in the current study, Honors Algebra 1 and Non-Honors Algebra 1. The Honors Algebra 1 course was considered more rigorous than Non-Honors Algebra 1 (Casad et al., 2017; Gentry & Owen,

2004; McCormick & Lucas, 2011; Tyson & Roksa, 2017). Rigor for mathematics courses is defined as the level of cognitive demands of instructional tasks during instruction for mathematical understanding (Boston & Wolf, 2006). The Honors course was designed to be college-preparatory and places additional demands on the students participating in the Honors course to increase critical thinking skills necessary for college readiness (Gamoran, Porter, Smithson, & White, 1997; Tsui, 1999). Gender of the student was self-reported as male or female on admission paperwork upon enrolling in school and was collected as part of the PSAT/NMSQT test information.

Research Questions

RQ1: Is there a statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not?

RQ2: Is there a statistically significant difference in college readiness between male and female Algebra 1 students in a private high school?

RQ3: Is there a statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not?

Hypotheses

$H_0 1$: There is no statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not.

$H_0 2$: There is no statistically significant difference in college readiness between male and female Algebra 1 students in a private high school.

H₀3: There is no statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not.

Participants and Setting

The participants for the study were drawn from a convenience sample of students located at a large private high school in southwestern Virginia during the spring semester of the 2017-2018 school year. The large private school is a faith-based PK-12 institution located in southwestern Virginia with approximately 2,000 total students. The high school (Grades 9-12) had 731 students in the 2017-2018 school year. The private high school population consisted of 351 (48%) female and 380 (52%) male students enrolled in the 2017-2018 school year. The high school student ages ranged from 14-19 years old. There were 162 students in 9th grade, 189 students in 10th grade, 177 students in 11th grade, and 203 students in 12th grade. The high school ethnicity makeup included 48% Caucasian students, 3% African American students, 6% Asian students, 1% Hispanic students, and 42% students of other ethnic origin. Other was classified as either not one of the ethnicities reported separately or not provided in the student demographic information.

The private school was a member of the state's private education association and was accredited through two valid and recognized accreditation agencies. The school's standards for graduation and courses had been approved by the state's board of education and most of the courses were approved by NCAA eligibility standards. The Honors Algebra 1 and Non-Honors Algebra 1 courses were both approved through these institutions and counted as a credit toward graduation requirements. The Honors Algebra 1 course was first offered in the 2015-2016 school year as an option for students versus the Non-Honors course. In order to enroll in the

Honors Algebra 1 course, students must have a final grade of an A in their previous Non-Honors Pre-Algebra math course or a B or better in their previous Honors Pre-Algebra course. Students must apply to take Honors courses each year and were expected to complete challenging work at a more rigorous pace compared with the Non-Honors math course. The faculty of the school must have, or be eligible to obtain, state teaching certification and become a member of one of the accreditation associations. The students taking either Algebra 1 course were taught on the school's campus, five days a week. Each class period was 50 minutes in length and included 36 weeks of instruction. The school's average class size was approximately 19 students.

Sample

The sample for the study included all the 10th-grade students enrolled in the 2017-2018 school year. The number of participants is 166 which exceeds the required minimum of 132 participants to obtain a medium effect size with statistical power of 0.7 at the 0.05 alpha level (Gall et al., 2007). The participants used in the study must have completed an Algebra 1 course, either Non-Honors or Honors, and have taken the PSAT/NMSQT to be utilized in the data analysis. Students had the option to take either of the Algebra 1 courses in 8th, 9th, or 10th grade. All 10th-grade students at the school were provided the opportunity to take the PSAT/NMSQT during normal school hours on a specific date in October. Students in the 9th and 1th grade may also take the PSAT/NMSQT with the 10th graders for a small fee. The 10th-grade population included 189 students; however, 23 had to be removed from the analysis because they had not completed an Algebra 1 course and/or did not have a PSAT/NMSQT score at the time of data retrieval.

The sample consisted of 75 (45%) females and 91 (55%) males from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications.

The students' average age was 16 years old. The participants include 139 (84%) Caucasian students, 5 (3%) African American students, 9 (5%) Asian students, 5 (3%) Latino students, and 8 (5%) students of other ethnic origin.

Groups

Non-Honors group. The Non-Honors Algebra 1 group consisted of 50 females and 68 males from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications. The students' average age was 16 years old. The participants included 98 (83%) Caucasian students, 4 (3%) African American students, 8 (7%) Asian students, 2 (2%) Latino students, and 6 (5%) students of other ethnic origin.

Non-Honors female group. The Non-Honors Algebra 1 female group consisted of 50 females from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications. The students' average age was 16 years old. The participants included 41 (82%) Caucasian students, 1 (2%) African American students, 5 (10%) Asian students, 0 (0%) Latino students, and 3 (6%) students of other ethnic origin.

Non-Honors male group. The Non-Honors Algebra 1 male group consisted of 68 males from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications. The students' average age was 16 years old. The participants included 57 (84%) Caucasian students, 3 (4%) African American students, 3 (4%) Asian students, 2 (3%) Latino students, and 3 (4%) students of other ethnic origin.

Honors group. The Honors Algebra 1 group consisted of 25 females and 23 males from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications. The students' average age was 16 years old. The participants included 41 (85%) Caucasian students, 1 (2%) African American students, 1 (2%) Asian students, 3 (6%) Latino

students, and 2 (4%) students of other ethnic origin.

Honors female group. The Honors Algebra 1 female group consisted of 25 females from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications. The students' average age was 16 years old. The participants included 20 (80%) Caucasian students, 1 (4%) African American students, 1 (4%) Asian students, 2 (8%) Latino students, and 1 (4%) students of other ethnic origin.

Honors male group. The Honors Algebra 1 male group consisted of 23 males from the 10th grade enrolled at the private school in the 2017-2018 school year that met participant qualifications. The students' average age is 16 years old. The participants include 21 (91%) Caucasian students, 0 (0%) African American students, 0 (0%) Asian students, 1 (4%) Latino students, and 1 (4%) students of other ethnic origin.

Instrumentation

The dependent variable for this study was college readiness as measured by the mathematics portion of the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT) test. The purpose of the exam was to gain an early measure of college readiness of the students (College Board, 2017; Proctor et al., 2010). Several recent studies have used the PSAT/NMSQT to gain a measure of students' college readiness (Bausmith & France, 2012; Koon & Petscher, 2016; Wighting et al., 2009). The PSAT/NMSQT is a standardized exam administered by College Board on the third Saturday of October and the previous Wednesday (Proctor et al., 2010). All 10th-grade students at the private high school were administered the PSAT/NMSQT on the Wednesday date during a normal school day. The exam took approximately three hours to complete (College Board, 2017). The PSAT/NMSQT

completed tests were sent to College Board for scoring. The College Board (2017) explains the

PSAT/NMSQT scoring process follows:

> To calculate section scores, we first compute the student's raw score—the number of
>
> questions correctly answered—for each section. Nothing is deducted for incorrect
>
> answers or for unanswered questions. Next, we convert each of the raw section scores to
>
> a scaled score of 160 to 760. This conversion process adjusts for slight differences in
>
> difficulty among versions of the test and provides a score that is consistent across
>
> different versions. The scaled scores are the scores provided on score reports. (p. 1)

The test scores were reported as a reading score, mathematics score, and a combined composite

score (reading plus mathematics). Only the mathematics scores were used for this study. The

highest mathematics score possible was 760, and the lowest possible mathematics score was 160

(College Board, 2017). All the student scores were sent back to the private high school in an

electronic spreadsheet. The spreadsheet reported each student's reading score, mathematics

score, and composite score. The scores were then manually entered into each student's school

record housed in the school's database by the guidance secretary.

The college entrance exams for SAT and PSAT/NMSQT are accepted at all major

universities in the United States and have been shown to be valid as indicators of college

readiness (Proctor et al., 2010). According to College Board (2017), the PSAT/NMSQT scores

should be interpreted as ranges rather than points. Marini, Mattern, and Shaw (2011) have

shown a positive linear relationship with the PSAT/NMSQT scores and first-year college GPA

for students scoring on all ends of the spectrum. Also, an early indicator of college readiness

scale has been developed based on the reliability of the PSAT/NMSQT scores (Kim,

Hendrickson, Patel, Melican, & Sweeney, 2014). The standard error of measurement (*SEM*) was

calculated for the 2017 PSAT/NMSQT which measures how students who took different forms of the test under the same conditions would likely earn scores within the range of the *SEM* for the two tests. The 2017 *SEM* for the mathematics portion of the PSAT was 38.08 and the standard deviation for the mathematics score was 92 (College Board, 2017).

Procedures

The researcher gained preliminary approval to use the private school student data from the superintendent of the private school to make sure the study would be feasible. See Appendix A for school permission. Prior to collecting any data, the researcher submitted the necessary application to the Liberty University Institutional Review Board (IRB) and received approval. See Appendix B for IRB approval. Once IRB approval was received, the researcher requested the archival data from the mathematics department chair of the private school. The math department chair ran a query from the school database to retrieve information of all 10th-grade students from the 2017-2018 school year to include demographic data, math courses, grades, and PSAT/NMSQT mathematics test scores. The school database demographic information was gathered from data self-reported on the student's application to the private school and included a student's name, age, birth date, ethnicity, current grade, and gender. The guidance secretary entered this information in the student records after the student was accepted into the school. A student's math courses and grades were entered into the student database records as they were earned. The PSAT/NMSQT scores were received as a spreadsheet for all students taking the test in the given year. The PSAT/NMSQT scores were kept in spreadsheet form and were manually entered into a student's record by the guidance secretary as time permitted.

Before giving the data to the researcher, the mathematics department chair merged the PSAT/NMSQT data into the student record and stripped it of any individual identifying

information such as student names. The data was downloaded into an Excel spreadsheet file and

given to the researcher on a USB drive. The researcher kept the data stored on the USB drive in

a locked safe while not using it. The researcher removed the student records from the dataset

that did not meet participant qualifications of completing an Algebra 1 course and/or having a

PSAT/NMSQT score available before the statistical analysis was completed.

The researcher used the Statistical Package for the Social Sciences (SPSS) software

program to run the statistical analysis. For each research question, the researcher computed both

visual and numeric summaries using the software.

Data Analysis

The variables of interest in this study were college readiness, the rigor of Algebra 1

course taken, and the gender of the student designated as either male or female. The dependent

variable was college readiness as measured by the mathematics portion of the PSAT/NMSQT.

The first independent variable was the course type of Algebra 1 taken and contained two

designations: Honors and Non-Honors. The second independent variable was gender. A

convenience sample of the 10th graders in the school was used as the data set. The dependent

variable, PSAT/NMSQT score, was measured on a continuous scale and the independent

variables, type of Algebra 1 course and gender were categorical. Descriptive statistics were

computed for the variables to describe demographics and the PSAT/NMSQT scores to include

the mean score, median score, range, and standard deviation.

A two-way analysis of variance (ANOVA) was used to determine the differences

between the groups. A 95% confidence level was used to determine statistical significance. This

was the common standard of confidence level for educational studies (Gall et al., 2007; Warner,

2008). A two-way ANOVA was the proper statistical test because the dependent variable was

measured on an interval or ratio scale and the multiple independent variables (Factors) were

categorical (Gall et al., 2007; Warner, 2008). A two-way ANOVA allowed for the two factors to

be analyzed simultaneously as well as check for interactions between the factors in an efficient

manner (Fraenkel et al., 2012). This type of statistical analysis allows for less error when

analyzing the effect of the factors on the dependent variable. Partial eta squared was interpreted

for a medium effect size with statistical power of 0.7 at the 0.05 alpha level (Gall et al., 2007).

There are various assumptions that must be tested when using a two-way ANOVA (Gall

et al., 2007; Green & Salkind, 2011; Warner, 2008). The first assumption is that the dependent

variable will be measured on an interval or ratio. College readiness was measured using

mathematics test scores from the PSAT/NMSQT. These scores were quantitative measurements

measured on a ratio scale. The next assumption is that data observations contain no extreme

outliers. Data screening was conducted using box-and-whisker plots for each of the groups

looking for outliers. Another assumption when using a two-way ANOVA is that the variables

are normally distributed (Gall et al., 2007). This assumption was assessed using the

Kolmogorov-Smirnov test and the Shapiro-Wilk test based on the sample size. Kolmogorov-

Smirnov was used for group size that was greater than 50 while the Shapiro-Wil test was used

for a group size less than 50 (Gall et al., 2007). The last assumption is that the population

distributions have the same variances. This was examined using Levene's Test for Equality of

Error Variance. Partial eta squared was used to determine the effect size (Warner, 2008). Using

this measure of effect size gives a practical strength of conclusions when a statistical significance

was found in the study (Creswell, 2015). The interpretation of effect size was based on the

partial eta squared statistic thresholds reported by Warner (2008): small effect when η^2 is less

.010, medium effect when η^2 is between .022 and .059, large effect when η^2 is between .083 and

.138, very large effect when η^2 is greater than .168.

CHAPTER FOUR: FINDINGS

Overview

The current study investigated the differences among college readiness and Algebra 1 course taken of 10th-grade male and female students who attend a private high school located in southwestern Virginia. This chapter contains the research questions, null hypotheses, and the data analysis results pertaining to the study.

Research Questions

RQ1: Is there a statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not?

RQ2: Is there a statistically significant difference in college readiness between male and female Algebra 1 students in a private high school?

RQ3: Is there a statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not?

Null Hypotheses

$H_0$1: There is no statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not.

$H_0$2: There is no statistically significant difference in college readiness between male and female Algebra 1 students in a private high school.

$H_0$3: There is no statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not.

Descriptive Statistics

Archival data was used for this study. The data was obtained by first gaining permission for its use from the superintendent of a private school in southwestern Virginia. After IRB approval was granted, the data was retrieved from the school database by the school's math department chair. Before giving the data to the researcher, the math department chair merged the PSAT/NMSQT data into the student record and stripped it of any individual identifying information such as student names. The data was downloaded into an Excel spreadsheet file and given to the researcher on a USB drive. The researcher removed the student records from the dataset that did not meet participant qualifications of completing an Algebra 1 course and/or having a PSAT/NMSQT score available before the statistical analysis was completed.

The sample was taken from the 10th-grade students who had completed an Algebra 1 course and received PSAT/NMSQT results by the spring semester of the 2017-2018 school year at a private school in southwestern Virginia. The dependent variable was college readiness as measured by the mathematics portion of the PSAT/NMSQT, and the independent variables were course type, designated as either Non-Honors or Honors, and gender.

Of the189 potential participants in the data sample, 23 were removed from the data set because they had not completed Algebra 1 and/or did not have a PSAT/NMSQT mathematics score. The remaining data from 166 participants was used in the study, and this exceeded the minimum requirement of 132 participants for a two-way ANOVA with a power of .07 at the .05 level (Gall et al., 2007). See Table 1 for the composition of the groups including gender and Algebra 1 course designation.

Table 1

Composition of Groups

	Algebra 1	Algebra 1 Honors	Total
Male	68	23	91
Female	50	25	75
Total	118	48	166

The dependent variable, college readiness, was measured by the mathematics PSAT/NMSQT test scores for each participant. The lowest score possible on the mathematics portion of the test was 170 and the highest score was 760 (College Board, 2017). Descriptive statistics in Table 2 include the means and standard deviations for each group.

Table 2

Descriptive Statistics for Mathematics PSAT/NMSQT Scores

Gender	Course	Mean	Std. Deviation	N
Male	Algebra I	461.18	64.704	68
	Algebra I Honors	562.17	61.419	23
	Total	486.70	77.374	91
Female	Algebra I	444.20	61.082	50
	Algebra I Honors	540.80	73.253	25
	Total	476.40	79.451	75
Total	Algebra I	453.98	63.490	118
	Algebra I Honors	551.04	67.987	48
	Total	482.05	78.250	166

Results

Data Screening

Data screening was conducted on the dependent variable for each group for data inconsistencies, outliers, and normality. The researcher visually inspected the PSAT/NMSQT test scores to check for inconsistencies making sure each was within the score parameters of 170 and 760. Box-and-whisker plots were used to examine the data for extreme outliers, and none were identified (see Figures 1 and 2).
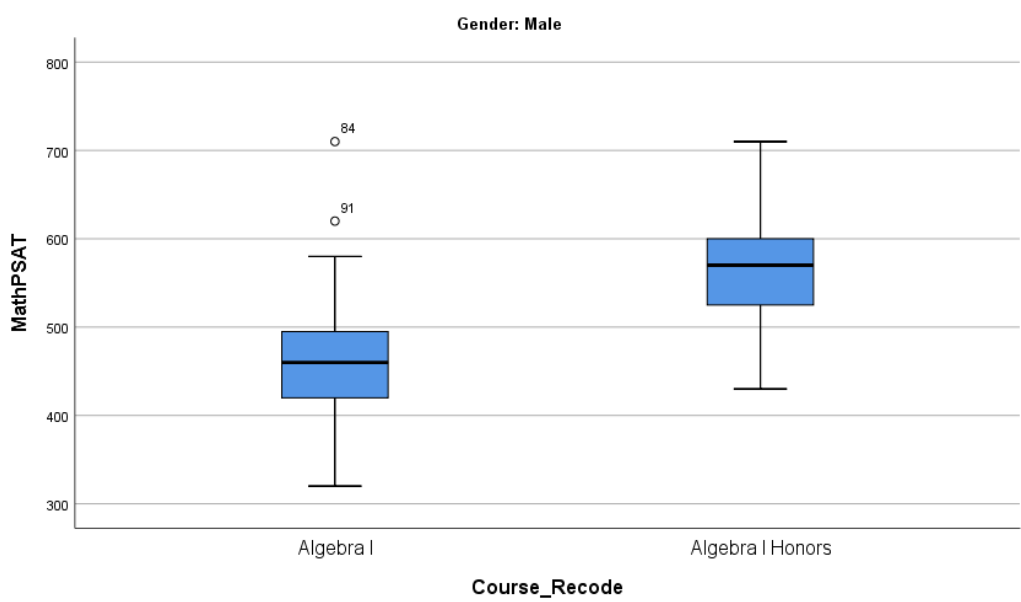

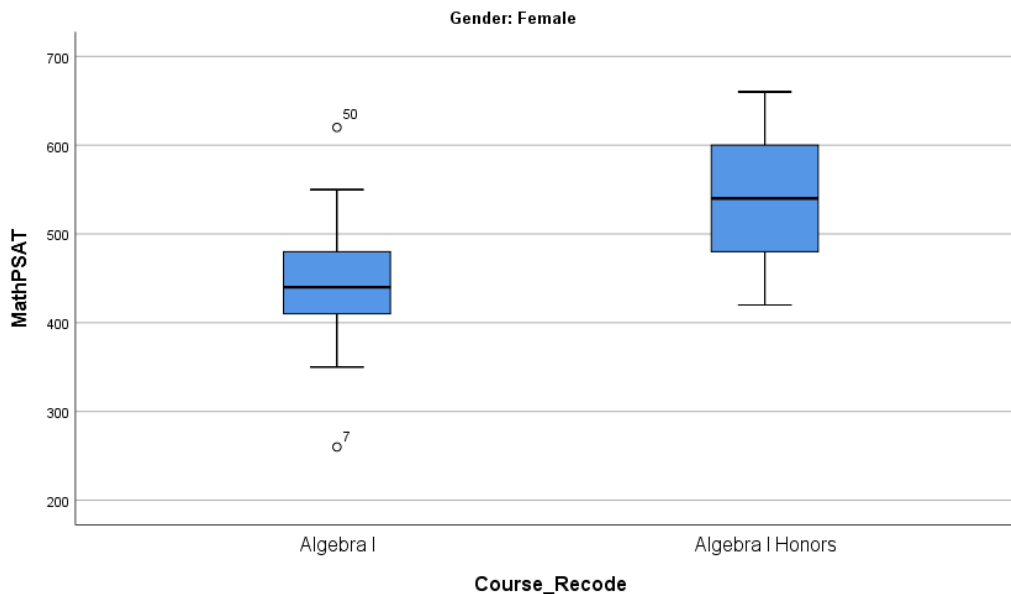*Figure 1.* Box-and-whisker plot for male group by course.

Figure 2. Box-and-whisker plot for female group by course.

Assumption Testing

A two-way ANOVA was conducted to test the null hypotheses, requiring several assumptions to be met. Normality of distributions for the dependent variable was examined using the Kolmogorov-Smirnov and visually confirmed using histograms (Gall et al., 2007; Green & Salkind, 2011; Warner, 2008). The Kolmogorov-Smirnov test was used to test normality as the sample size was over 50 (Gall et al., 2007; Green & Salkind, 2011; Warner, 2008). Table 3 shows the normality testing results and Figures 3, 4, and 5 display the distribution histograms.

The Kolmogorov-Smirnov test for the female group ($M = 476.40$, $SD = 49.45$) revealed a non-normal distribution of the dependent variable ($p = .038$). However, inspection of a histogram revealed the distribution of the dependent variable for the female group was approximately normal allowing the assumption of normal distribution to be met and analysis to continue. The female groups, Female Honors Algebra 1 ($M = 540.80$, $SD = 73.25$) and Female Non-Honors Algebra 1 ($M = 444.20$, $SD = 61.08$), met the normality requirements in both testing

and visual inspection of the histograms (see Tables 3 and 4). The male group ($M = 486.70$, $SD = 77.37$) met the requirements for normality by both testing and inspection. The male subgroups, Male Honors Algebra 1 ($M = 562.17$, $SD = 61.42$) and Male Non-Honors Algebra 1 ($M = 61.18$, $SD = 64.70$), also met the requirements for normality by both testing and inspection (see Table 3 and Figure 5).

Table 3

Normality Test by Gender

	Gender	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
MathPSAT	Female	.105	75	.038	.970	75	.077
MathPSAT	Male	.076	91	.200[*]	.979	91	.142

Table 4

Normality Test by Gender and Course

Gender		Course	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
Female	MathPSAT	Algebra I	.087	50	.200[*]	.976	50	.385
		Algebra I Honors	.100	25	.200[*]	.957	25	.353
Male	MathPSAT	Algebra I	.083	68	.200[*]	.956	68	.018
		Algebra I Honors	.091	23	.200[*]	.976	23	.838

Histogram

Gender= Female. for Gender_Recode= Female

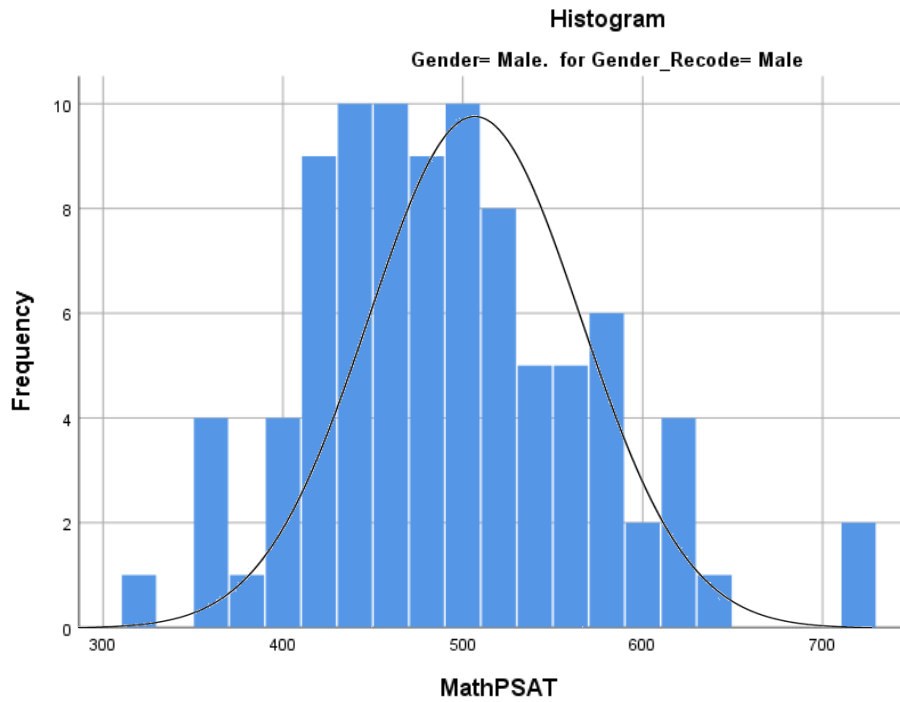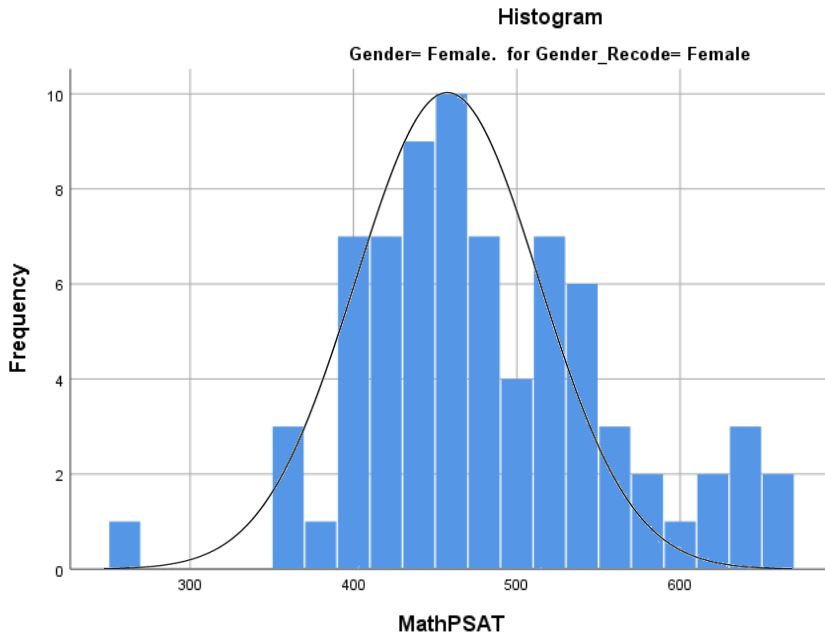### Histogram

Gender= Male. for Gender_Recode= Male
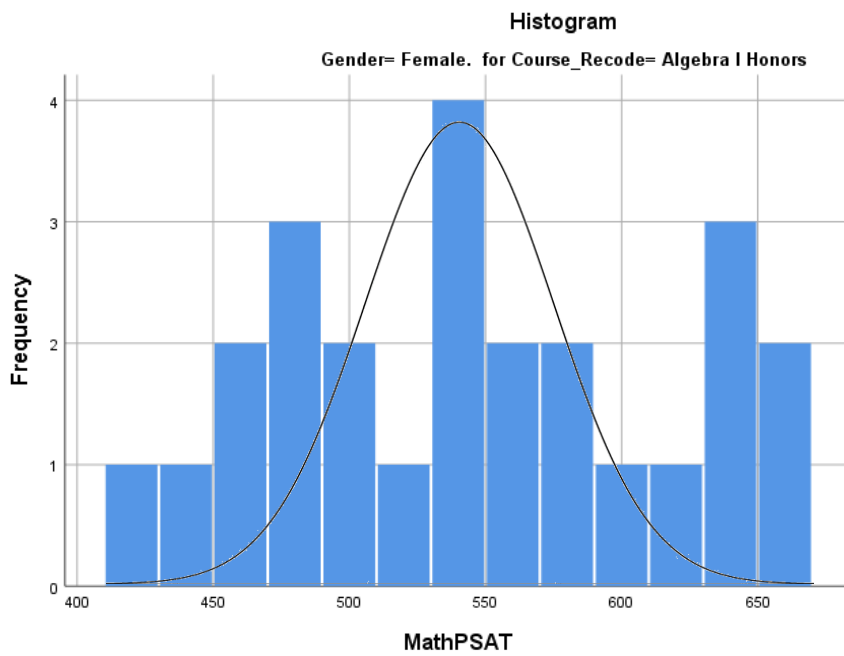

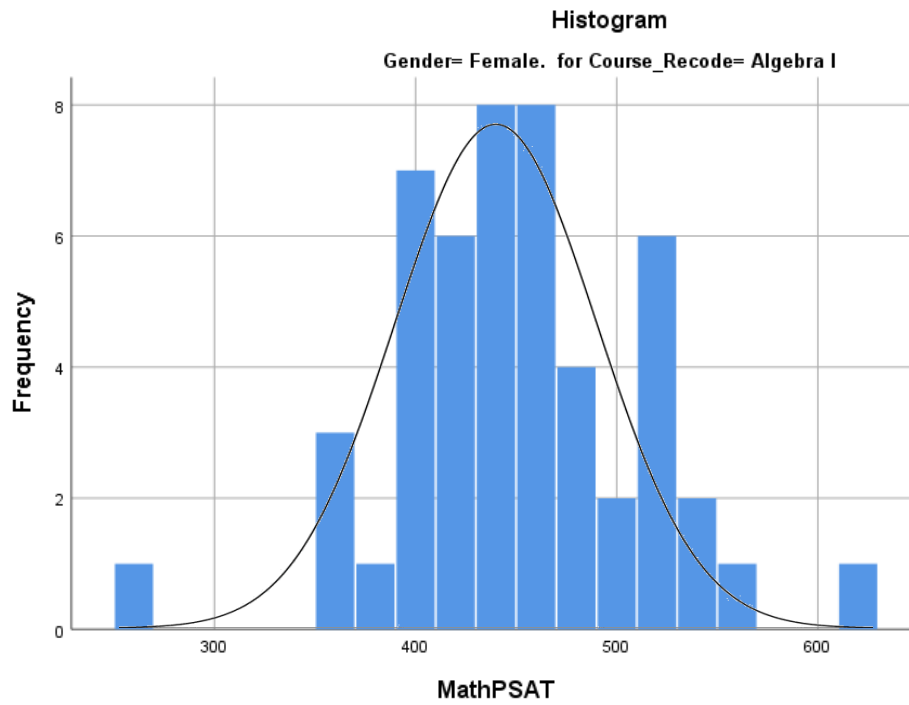*Figure 3*. Distribution graphs by gender.

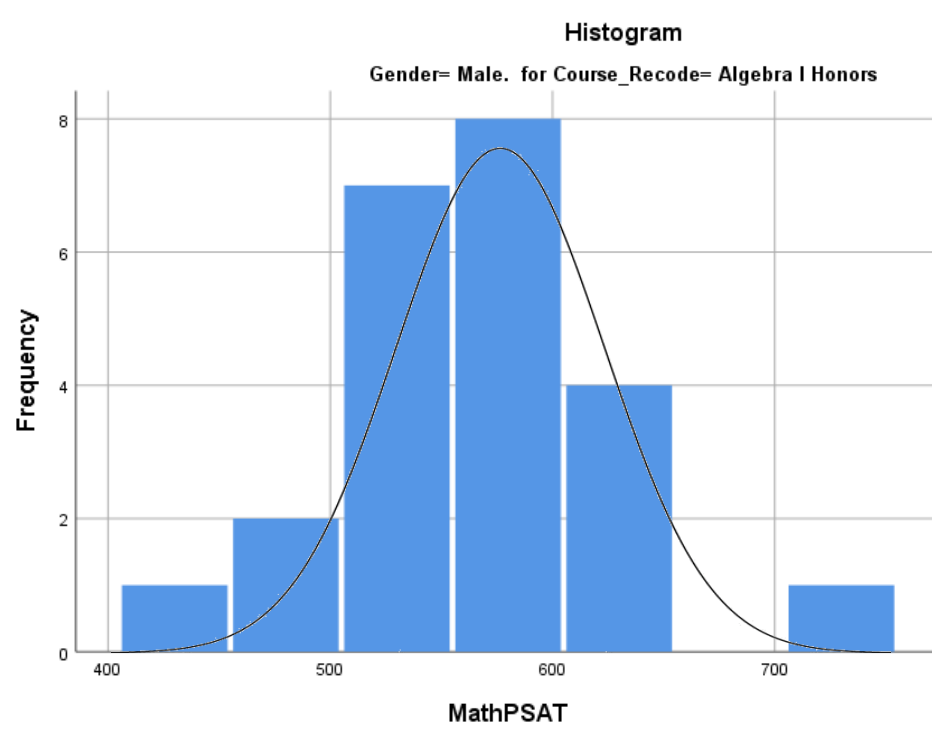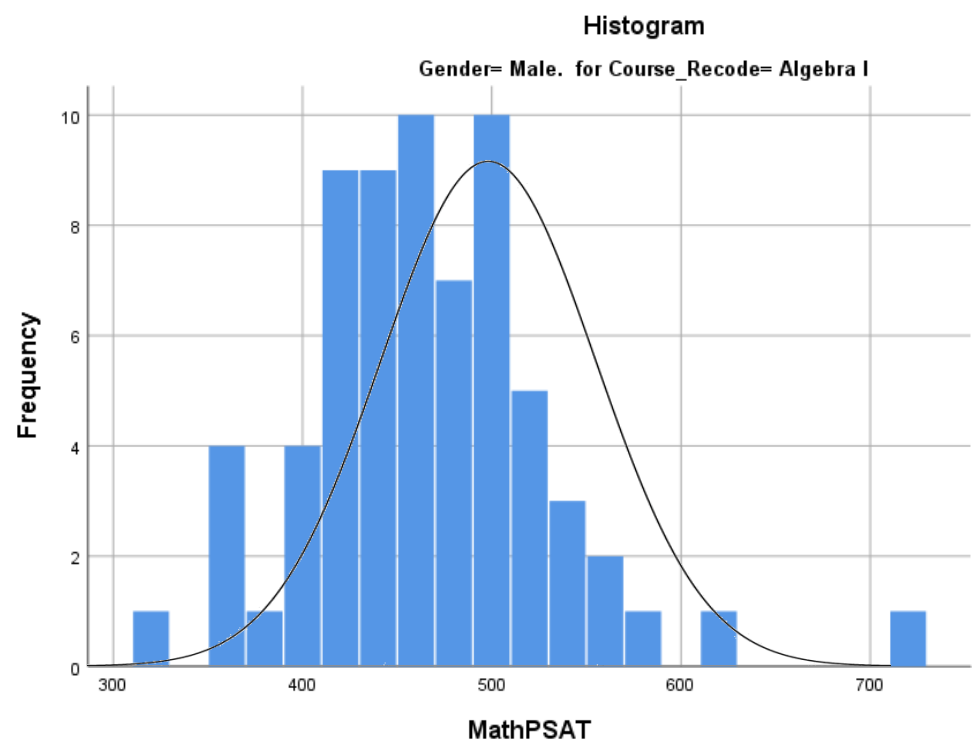*Figure 4.* Distribution graphs for female groups.

Figure 5. Distribution graphs for male groups.

The next assumption tested was the assumption of homogeneity of variance. Levene's

test of equality of variance was examined, and no violation was found $F(3,162) = .743$, $p = 0.528$

(see Table 5).

Table 5

Levene's Test of Equality of Error Variances[a,b]

Dependent Variable: Math PSAT	F	df1	df2	Sig.
	.743	3	162	.528

Note. Tests the null hypothesis that the error variance of the dependent variable is
equal across groups.[a,b]

a. Dependent variable: Math PSAT
b. Design: Intercept + Gender + Course + Gender * Course

Two-way ANOVA Results

A two-way ANOVA was used to test the first null hypothesis at the 95% confidence

level: There is no statistically significant difference in college readiness between students who

have taken an Honors Algebra 1 course in a private high school and those who have not. This

hypothesis addressed the first independent variable of Algebra 1 course type on the dependent

variable of college readiness. The Algebra I course type consisted of two designations, Honors

Algebra 1 and Non-Honors Algebra 1. The dependent variable was measured by the

PSAT/NMSQT math test score.

The results of the ANOVA revealed a statistically significant difference, $F(1,162) =$

79.278, $p =.000$, partial $\eta^2 = .329$, in college readiness for students taking Honors Algebra I ($M =$

551.04, $SD = 67.99$) when compared to students taking Non-Honors Algebra I ($M = 453.98$, SD

$= 63.49$). The partial eta squared statistic showed a very large effect size (Warner, 2008). Table

4.5 provides the Tests of Between-Subjects Effects results for the ANOVA analysis.

A two-way ANOVA was used to test the second null hypothesis at the 95% confidence level: There is no statistically significant difference in college readiness between male and female Algebra 1 students in a private high school. The second null hypothesis was not rejected revealing no statistically significant difference between male ($M = 486.70$, $SD = 77.37$) and female ($M = 476.40$, $SD = 79.45$) Algebra 1 students' college readiness, $F(1,162) = 2.986$, $p = .086$, partial $\eta^2 = .018$. Table 5 provides the Tests of Between-Subjects Effects results.

A two-way ANOVA was used to test the third null hypothesis at the 95% confidence level: There is no statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not. The third null hypothesis was not rejected, showing no statistically significant interaction between male and female students' college readiness when considering their Algebra 1 course designation as either Honors or Non-Honors, $F(1,162) = .039$, $p = .843$, partial $\eta^2 = .000$. The means and standard deviations by group were as follows: Female-Honors ($M = 540.80$, $SD = 73.25$), Female-Non-Honors ($M = 444.20$, $SD = 61.08$), Male-Honors ($M = 562.17$, $SD = 61.42$), Male-Non-Honors ($M = 461.18$, $SD = 64.70$). Table 6 provides the Tests of Between-Subjects Effects results. The result of no interaction was visually confirmed by the plot of marginal means revealing no intersection of the graphs between the groups. See Figure 6 for the Estimated Marginal Means Plot.

Table 6

Tests of Between-Subjects Effects: Math PSAT

| Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	335204.428[a]	3	111734.809	26.812	.000	.332
Intercept	34128700.801	1	34128700.801	8189.685	.000	.981
Gender	12444.579	1	12444.579	2.986	.086	.018
Course	330372.148	1	330372.148	79.278	.000	.329
Gender * Course	163.622	1	163.622	.039	.843	.000
Error	675099.187	162	4167.279			
Total	39583800.00	166				
Corrected Total	1010303.614	165				
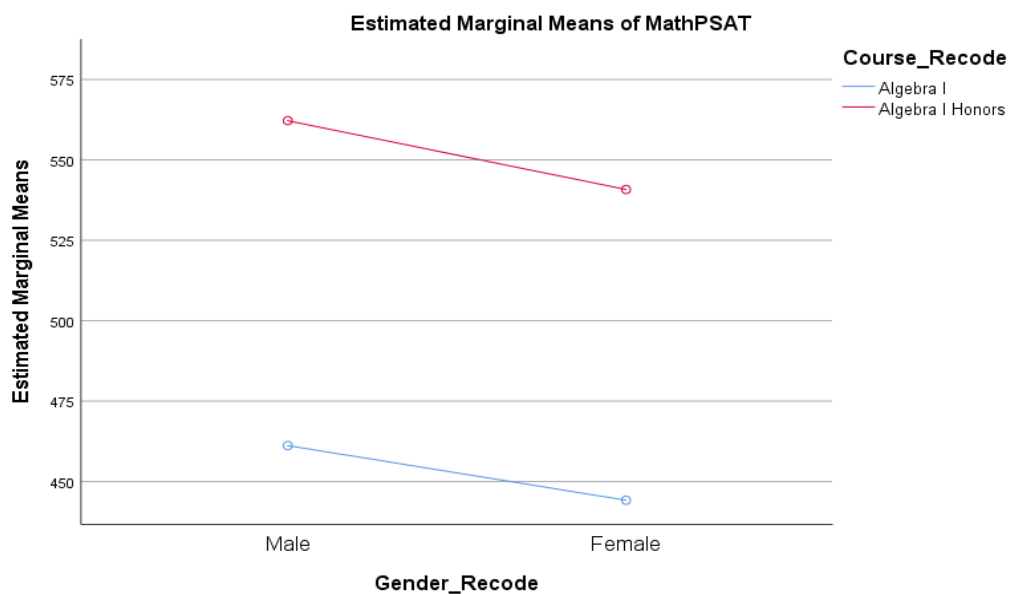
Figure 6. Estimated marginal means plot.

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter begins with a discussion of the analysis results pertaining to the research questions and null hypotheses. Implications of this study's findings, limitations, and recommendations for future research follow the discussion. The current study found that there was a statistically significant difference in the college readiness of private school students who took Honors Algebra 1 than those who did not. The findings for this research correlate to previous research studies and theories, and it adds to the existing body of literature regarding the rigor of math course especially in the private education sector.

Discussion

The purpose of this study was to investigate the differences in college readiness between students who took Honors Algebra 1 and those who did not. A quantitative causal-comparative design was implemented to determine the main effect differences as well as the interaction among gender and course designation. The PSAT/NMSQT math scores were used to determine students' college readiness and analyzed based on the type of Algebra 1 course taken: Honors or Non-Honors. Determining if students benefit from taking an Honors Algebra 1 course may give students the best opportunity to be prepared for higher education (Cromwell et al., 2013; Kim et al., 2014; Hein et al., 2013). The results of this study suggest decision makers should encourage students to begin taking Honors math courses with their earliest foundational math course, Algebra 1, in order to reach a higher level of college readiness.

College readiness has long been a focus for educators and has become a priority to ensure economic success for students (Wyatt et al., 2014). The current study was designed to research the following three questions and corresponding null hypotheses related to college readiness for

students in private school:

RQ1: Is there a statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not?

RQ2: Is there a statistically significant difference in college readiness between male and female Algebra 1 students in a private high school?

RQ3: Is there a statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not?

H$_0$1: There is no statistically significant difference in college readiness between students who have taken an Honors Algebra 1 course in a private high school and those who have not.

H$_0$2: There is no statistically significant difference in college readiness between male and female Algebra 1 students in a private high school.

H$_0$3: There is no statistically significant interaction in college readiness between male and female students who have taken an Honors Algebra 1 course in a private high school and those who have not.

The results for the first research question indicates there is a statistically significant difference in college readiness for students who take Honors Algebra 1 ($M = 551.04$, $SD = 67.99$) when compared to those who take Non-Honors Algebra 1 ($M = 453.98$, $SD = 63.49$) ($p = .000$, partial $\eta^2 = .329$). This result supports previous research which has found academic rigor enhances college readiness (Bancroft et al., 2017; Cromwell et al., 2013; Houser & An, 2015). When studying the effect of course rigor on college readiness, many studies focused on higher-level mathematics courses such as Algebra 2. However, Conley (2007) suggested course selections even in middle school play a part in a student's college readiness. The current study

supports Conley's proposition because many students who take Honors Algebra 1 typically take the course before entering high school (Conley, 2007; Spielhagen, 2006). Long et al. (2012) also found that students taking even one rigorous math course early in their secondary education significantly increase 10th-grade math achievement. Additionally, Long et al. (2012) found students who take rigorous coursework earn more college credits and obtain higher GPAs in college.

The results of this study also support the findings that students who enroll in rigorous math courses obtain greater college readiness as a result of their increased self-efficacy and growth mindset. Students who choose to take Honors-level courses have been shown to have a higher level of self-efficacy and hold to incremental intelligence theory, or growth mindset (Bandura & Wood, 1989; Conley, 2007; Romero et al., 2014) The current study also supports the theories of self-efficacy and growth mindset by showing students who take the rigorous Honors Algebra 1 course may obtain a significantly higher level of college readiness than those who took the Non-Honors Algebra 1 course. Blackwell and Dweck (2007) found students with growth mindset typically chose rigorous coursework and were able to stay focused through challenge and failure, leading to higher student achievement. Growth mindset was also found to be a significant predictor of mathematics achievement even by the end of the eighth grade (Blackwell & Dweck, 2007). Bandura (1993) found that higher self-efficacy led to a student's ability to master academic topics and increase academic performance. Additionally, van Rooij et al. (2017) found higher perceived self-efficacy was a critical predictor of academic success including college readiness. The students who would be eligible for the Honors Algebra 1 course may have a higher self-efficacy and growth mindset due to previous academic performance and motivation for choosing challenging coursework. Therefore, the theories

would suggest Honors students should have increased college readiness compared to Non-Honors Algebra 1 students.

The second research question found no statistically significant difference in male ($M = 486.70$, $SD = 77.37$) and female ($M = 476.40$, $SD = 79.45$) students' college readiness ($p = .086$, partial $\eta^2 = .018$). While no statistically significant difference was found, the small difference in the math PSAT/NMSQT scores corresponds to research results published from the 2003 TIMSS which showed very little difference in math college readiness between genders (Else-Quest et al., 2010). While in earlier studies, male students were shown to have higher college entrance scores (Harris & Carlton, 1993), many current studies show little to no difference in college entrance scores. Nankervis (2013) recently found males had slightly higher PSAT scores overall, yet many recent studies find no significant differences in male and female college readiness scores (Houser & An, 2015; Long et al., 2009; Long et al., 2012; Reilly et al., 2015). Closing the gender gap has been an area of concern in education since the 1980s which has helped decrease the differences in college readiness between gender. The decline in differences may also be due to the increase of females participating in higher-level mathematics and college preparatory courses overall (Long et al., 2009).

The current research result also supports recent research regarding incremental intelligence theory and self-efficacy theory. Romero et al. (2014) found no gender differences relating to student's espoused intelligence theory, and van Rooij et al. (2017) found no gender differences relating to self-efficacy. However, early studies showed males had higher self-efficacy than females, and self-efficacy was a significant predictor of mathematics performance. This finding may imply that males had greater academic success in math in previous years (Pajares & Miller, 1994). Other studies found females pursuing higher mathematics had a higher

level of self-efficacy in order to overcome stereotypes and also, females tend to take more rigorous courses than males (Bussey & Bandura, 1999; Zeldin & Pajares, 2000). According to Bem's gender schema theory, the discrepancy between male and female academic performance in mathematics has been suggested to be a part of sex-typing, where math is seen as a masculine-type of course leading to male-dominated occupations (Bem, 1981; Casey et al., 1997; Cheryan, 2012; Reilly et al., 2015). The current study neither confirms nor contradicts Bem's theory since there were slight differences with gender, but none were statistically significant. There has been a large movement to encourage females to take higher-level mathematics and pursue occupations in STEM fields. This movement may have countered the previous discrepancies in gender differences regarding mathematics achievement and college readiness. While gender differences in college readiness have decreased, they have not disappeared (Casad et al., 2017; Casey et al., 1997; Cheryan, 2012; NAEP, 2009; Reilly et al., 2015). These discrepancies continue to make gender an important factor to include in research (Starr & Zurbriggen, 2017).

The results for the third research question show no statistically significant interaction between college readiness of male and female students who have taken an Honors Algebra 1 course and those who have not. Both male and female students of the Honors Algebra 1 course scored equally higher than both male and female students of the Non-Honors Algebra 1 course respectively. The discussion above regarding gender and college readiness certainly show the current education strategies to close the gender gap in mathematics may be working. With males and females earning the same number of math credits and females increasing their enrollment in rigorous college preparatory math courses, the differences between genders have closed significantly regarding college readiness (Combs et al., 2010; Houser & An, 2015; Long et al., 2009; Reilly et al., 2015). This suggests that a focus on the rigor of math courses may help

students prepare for higher education (Bancroft et al., 2017; Cromwell et al., 2013; Houser & An, 2015; Long et al., 2009; Long et al., 2012; NAEP, 2009). The current study results support a focus on adding rigor to a student's secondary mathematics coursework as one effective method to increase college readiness.

Implications

College readiness has been a focus and priority for many years due to a large number of students who must take remedial courses upon entering higher education (Conley, 2007; U.S. Department of Education, 2010; Wyatt et al., 2014). The current study supports research in regard to taking Honors mathematics courses which can affect students' college readiness. Conley (2007) and Hein et al. (2013) state students who begin taking rigorous courses, such as Honors and Pre-AP, earlier in secondary school increase college readiness and increase the probability of academic success in higher education. Because this study was designed to only review the scores based on the foundational mathematics course of Algebra 1, many of the students in the Honors section would have taken the course early in their secondary education, likely in the eighth or ninth grade (Spielhagen, 2006). The results showed the students in the Honors Algebra 1 section have a higher level of college readiness which supports Conley (2007) and Hein et al.'s (2013) position. When students are college-ready, they decrease the need for remedial coursework, increase the probability of completing their degree, and complete their bachelor's degrees in less time (Adelman, 2006; Kaliski & Godfrey, 2014; Martinez & Klopott, 2005; Royster et al., 2015). These benefits all promote economic success for both the student and higher education institutions (Adelman, 2006; Danziger & Ratner, 2010; Heller, 2017; Wyatt et al., 2014).

Many studies have researched the course of study that best prepares students for college. However, those studies have focused on public education, leaving the private school population unstudied. The current study identified students from a large private school in southwest Virginia to determine the differences in college readiness of students who take Honors Algebra 1 and those who did not. This study found a statistically significant difference in the college readiness of the Honors Algebra 1 students, potentially assisting the private school population with course opportunities. Having the study completed with the private school population also helps to validate the rigorous curriculum private schools have to offer as many promote college preparedness programs (Green, Henseke, & Vignoles, 2017; Parker, Cook, & Pettijohn, 2007).

Limitations

There were several limitations that need to be addressed regarding both the internal and external validity of the current study. The internal validity was threatened due to the use of the convenience sample of 10th-grade students. However, the 10th-grade students were the only students who had the opportunity to choose between Honors and Non-Honors Algebra 1. Furthermore, the data was archival and could not be manipulated by the researcher.

External threats to validity include the specific population and setting used for the research study. Generalizability is limited to suburban private school areas of similar size and demographics as the study private school was located in a southwestern Virginia city. The sample population demographics lacked racial diversity as it consisted of 84% Caucasian students. While the sample demographics matched those of the study population, a more diverse sample may have produced different results and increased the external validity and generalizability.

Recommendations for Future Research

The current research is significant because it showed that private school students who take Honors Algebra 1 have statistically higher college readiness as measured by the math PSAT/NMSQT score than those who do not. Algebra 1 is a foundational course for all higher mathematics, so researching how this course impacts college readiness is important to help schedule students early in their high school course work. Recommended future research studies include those that will add to the existing body of research related to private schooling and the comparison between public and private schools which include the following:

1. Replicating this study in different states and regions would enhance the validity of this study and show private schooling holds to higher expectations regarding their Honors coursework and provide generalizability.

2. Researching private school students that stay in the Honors track after Algebra 1 versus those that do not take Honors mathematics courses throughout their high school career and the effect it has on their college readiness.

3. Investigating the differences in college readiness of public and private school students across different regions of a state for those that take Honors Algebra 1 and those that do not.

4. Investigating the differences of private school students' college readiness as measured by the reading score on the PSAT/NMSQT for those who take Honors English and those who do not. This would measure the reading component to college readiness and allow for a complete view of college readiness as a product of Honors coursework.

REFERENCES

Abraham, R. A., Slate, J. R., Saxon, D. P., & Barnes, W. (2014). College-readiness in math: A conceptual analysis of the literature. *Research & Teaching in Developmental Education, 30*(2), 4-34.

Achieve, Inc. (2014). *Rising to the challenge: Are high school graduates prepared for college and work?* Retrieved from https://www.achieve.org/files/RisingtotheChallengeresearchPPT11-2014.pdf

Achieve, Inc. (2017). *What is college and career readiness?* Retrieved from https://www.achieve.org/files/Achieve_Def_No%20Crop.pdf

ACT. (2011). *The condition of college and career readiness 2011.* Retrieved from http://www.act.org/research/policymakers/cccr11/pdf/ConditionofCollegeandCareerReadiness2011.pdf

Adelman, C. (2006). The toolbox revisited: Paths to degree completion from high school through college. U.S. Department of Education.

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing stereotype threat and boosting academic achievement of African-American students: The role of conceptions of intelligence. *Journal of Experimental Social Psychology*, *38*, 113-125.

Bancroft, A., Bratter, J., & Rowley, K. (2017). Affirmation effects on math scores: The importance of high school track. *Social Science Research*, *64*, 319-333.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191-215.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117.

Bandura, A., & Wood, R. (1989). Effect of perceived controllability and performance standards on self-regulation of complex decision making. *Journal of Personality and Social Psychology*, *56*(5), 805.

Bandura, A. (2000). Cultivate self-efficacy for personal and organizational effectiveness. *Handbook of Principles of Organization Behavior*, *2*, 0011-21.

Barnes, W. B., & Slate, J. R. (2013). College-readiness is not one-size-fits-all. *Current Issues in Education*, *16*(1).

Bausmith, J. M., & France, M. (2012). The impact of GEAR UP on college readiness for students in low income schools. *Journal of Education for Students Placed at Risk*, *17*(4), 234-246.

Beekman, J. A., & Ober, D. (2015). Gender gap trends on mathematics exams position girls and young women for STEM careers. *School Science & Mathematics*, *115*(1), 35-50.

Bem, S. L. (1981). Gender schema theory: A cognitive account of sex typing. *Psychological Review*, *88*(4), 354.

Berger, R. L., & Winter, J. V. (2016). Does private schooling increase adult earnings? Cohort-level evidence for U.S. states. *The Review of Regional Studies, 46*(3), 281-294.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*(1), 246-263.

Boston, M., & Wolf, M. K. (2006). Assessing academic rigor in mathematics instruction: The development of the instructional quality assessment toolkit. CSE Technical Report 672. *National Center for Research on Evaluation, Standards, and Student Testing*.

Braun, H., Jenkins, F., & Grigg, W. (2006). Comparing private schools and public schools using hierarchical linear modeling. NCES 2006-461. *National Center for Education Statistics*.

Broughman, S. P., Rettig, A., & Peterson, J. (2017). Characteristics of private schools in the United States: Results from the 2015-16 private school universe survey. First Look. NCES 2017-073. *National Center for Education Statistics*.

Bryan, J., Young, A., Griffin, D. C., & Henry, L. (2015). Preparing students for higher education: How school counselors can foster college readiness and access. In J. L. DeVitis & P. Sasso (Eds.). *Higher Education and Society*. New York: Peter Lang.

Bussey, K., & Bandura, A. (1999). Social cognitive theory of gender development and differentiation. *Psychological Review*, *106*(4), 676.

Camara, W. (2013). Defining and measuring college and career readiness: A validation framework. *Educational Measurement: Issues and Practice*, *32*(4), 16-27.

Carbonaro, W., & Covay, E. (2010). School sector and student achievement in the era of standards based reforms. *Sociology of Education*, *83*(2), 160-182.

Carpenter, D. M., Keith, R. S., & Catt, A. D. (2016). The private school landscape: The effects of school choice on student capacity and composition. EdChoice.org.

Casad, B. J., Hale, P., & Wachs, F. L. (2017). Stereotype threat among girls: Differences by gender identity and math education context. *Psychology of Women Quarterly*, *41*(4), 513-529.

Casey, M. B., Nuttall, R. L., & Pezaris, E. (1997). Mediators of gender differences in mathematics college entrance test scores: A comparison of spatial skills with internalized beliefs and anxieties. *Developmental Psychology*, *33*(4), 669.

Cheryan, S. (2012). Understanding the paradox in math-related fields: Why do some gender gaps

    remain while others do not? *Sex Roles*, *66*(3-4), 184-190.

Cheryan, S., Drury, B. J., & Vichayapai, M. (2013). Enduring influence of stereotypical

    computer science role models on women's academic aspirations. *Psychology of Women*

    Quarterly, *37*(1), 72-79.

Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty

    on academic achievement. *Proceedings of the National Academy of Sciences*, *113*(31),

    8664-8668.

College Board. (2017). *PSAT 10 Understanding Scores 2017.* Retrieved from

    https://collegereadiness.collegeboard.org/pdf/psat-10-understanding-scores-2017.pdf

College Board. (2018). *About us*. Retrieved from https://www.collegeboard.org/about

Coleman, J. (1981). Public schools, private schools, and the public interest. *The Public Interest,*

    64, 19-30.

Combs, J., Slate, J., Moore, G., Bustamante, R., Onwuegbuzie, A., & Edmonson, S. (2010).

    Gender differences in college preparedness: A statewide study. *Urban Review*, *42*(5),

    441-457.

Conley, D. T. (2003). *Understanding university success*. Eugene, OR: Center for Educational

    Policy Research, University of Oregon.

Conley, D. T. (2007). Redefining college readiness. *Educational Policy Improvement Center*

    (NJ1). Retrieved from https://eric.ed.gov/?id=ED539251

Conley, D. T., & McGaughy, C. (2012). College and career readiness: Same or different?

    Educational Leadership, 28-34.

Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (5th ed.). Upper Saddle River, NJ: Prentice Hall, Inc.

Cromwell, A., McClarty, K. L., & Larson, S. J. (2013). College readiness indicators. *Bulletin*, (25).

Dalton, B., Ingels, S. J., Downing, J., & Bozick, R. (2007). Advanced mathematics and science coursetaking in the spring high school senior classes of 1982, 1992, and 2004. Statistical Analysis Report. NCES 2007-312. *National Center for Education Statistics*.

Danziger, S., & Ratner, D. (2010). Labor market outcomes and the transition to adulthood. *Future of Children, 20*(1), 133-158.

Duggan, M. H. (2009). Is all college preparation equal? Pre-community college experiences of home-schooled, private-schooled, and public-schooled students. *Community College Journal of Research and Practice*, *34*(1-2), 25-38.

Dweck, C. S. (2009). Can personality be changed? The role of beliefs in personality and change. *Current Directions in Psychological Science, 17*(6), 391-394.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 109-116.

Dweck, C. S. (2014). Mindsets and math/science achievement. Retrieved from http://www.growthmindsetmaths.com/uploads/2/3/7/7/23776169/mindset_and_math_science_achievement_-_nov_2013.pdf

Edmunds, J. A., Bernstein, L., Unlu, F., Glennie, E., Willse, J., Smith, A., & Arshavsky, N. (2012). Expanding the start of the college pipeline: Ninth-grade findings from an experimental study of the impact of the early college high school model. *Journal of Research on Educational Effectiveness*, *5*(2), 136-159.

Eldridge, G. (2017). How do kids think about effort and ability? *International Educator*, *32*(2), 15

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Few gender differences in math abilities, worldwide study finds. *Science Daily, 136*(1), 103-127.

Ewing, M. (2007). Using multilevel modeling to predict performance on Advanced Placement examinations.

Ewing, M., & Wyatt, J. (2017). AP Potential Expectancy Tables Based on PSAT/NMSQT and SAT Scores on the 2015-16 Redesigned Scales Using Final Concordance Tables. Statistical Report. *College Board*.

Focareto, N. (2006). Private vs. non-private: A correlational study between ACT and GPA. (Electronic Thesis or Dissertation). Retrieved from http://etd.ohiolink.edu

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed.). New York: McGraw-Hill.

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). *Educational research: An introduction* (8th ed.). New York, NY: Allyn & Bacon.

Gamoran, A., Porter, A. C., Smithson, J., & White, P. A. (1997). Upgrading high school mathematics instruction. *Educational Evaluation and Policy Analysis, 19*, 325-338.

Geiser, S., & Santelices, V. (2004). The role of Advanced Placement and Honors courses in college admissions. Berkeley, CA: Center for Studies in Higher Education, University of California, Berkeley. Retrieved from http://professionals.collegeboard.com/profdownload/ the-role-of-ap-and-Honors-courses-in-college-admissions.pdf

Gentry, M., & Owen, S. V. (2004). Secondary student perceptions of classroom quality: Instrumentation and differences between advanced/Honors and nonHonors classes. *Journal of Secondary Gifted Education*, *16*(1), 20-29.

Giani, M., Alexander, C., & Reyes, P. (2014). Exploring variation in the impact of dual-credit coursework on postsecondary outcomes: A quasi-experimental analysis of Texas students. *The High School Journal, 97*(4), 200-218.

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology*, *24*(6), 645-662.

Gore, P. A., Jr. (2006). Academic self-efficacy as a predictor of college outcomes: Two incremental validity studies. *Journal of career assessment*, *14*(1), 92-115.

Gottfried, M., Owens, A., Williams, D., Kim, H. Y., & Musto, M. (2017). Friends and family: A literature review on how high school social groups influence advanced math and science coursetaking. *Education Policy Analysis Archives*, *25*, 62.

Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology*, 85, 541-553.

Green, F., Henseke, G., & Vignoles, A. (2017). Private schooling and labour market outcomes. *British Educational Research Journal*, *43*(1), 7-28.

Green, S. B., & Salkind, N.J. (2011). *Using SPSS for Windows and Macintosh: Analyzing and understanding data.* Upper Saddle River, NJ: Prentice Hall.

Harris, A. M., & Carlton, S. T. (1993). Patterns of gender differences on mathematics items on the Scholastic Aptitude Test. *Applied Measurement in Education*, *6*(2), 137-151.

Hein, V., Smerdon, B., & Sambolt, M. (2013). Predictors of postsecondary success. *College and Career Readiness and Success Center*. Retrieved from http://files.eric.ed.gov/fulltext/ED555671.pdf

Heller, R. (2017). What studies say about college readiness. *EWA Research Brief*. Retrieved from https://www.ewa.org/sites/main/files/file-attachments/ewabrief-collegereadiness-revised2.pdf

Hoffman, N., Vargas, J., & Santos, J. (2009). New directions for dual enrollment: Creating stronger pathways from high school through college. *New Directions for Community Colleges*, *2009*(145), 43-58.

Houser, L. C., & An, S. (2015). Factors affecting minority students' college readiness in mathematics. *Urban Education*, *50*(8), 938-960.

Jerrim, J., Parker, P. D., Chmielewski, A. K., & Anders, J. (2015). Private schooling, educational transitions, and early labour market outcomes: Evidence from three anglophone countries. *European Sociological Review*, *32*(2), 280-294.

Kaliski, P. K., & Godfrey, K. E. (2014). Does the level of rigor of a high school science course matter? An investigation of the relationship between science courses and first-year college outcomes. Research Report 2014-2. *College Board*. Retrieved from http://files.eric.ed.gov/fulltext/ED564301.pdf

Kim, Y-K, Hendrickson, A., Patel, P., Melican, G., & Sweeney, K. (2014). Development of a new ReadiStep™ scale linked to the PSAT/NMSQT® scale. Retrieved from http://research.collegeboard.org/sites/default/files/publications/2014/7/development-newreadistep-scale-psat-nmsqt.pdf

Koon, S., & Petscher, Y. (2016). Can scores on an interim high school reading assessment

    accurately predict low performance on college readiness exams? REL 2016-124.

    Regional Educational Laboratory Southeast. Retrieved from

    https://files.eric.ed.gov/fulltext/ED565632.pdf

Lefebvre, P., Merrigan, P., & Verstraete, M. (2011). Public subsidies to private schools do make

    a difference for achievement in mathematics: Longitudinal evidence from Canada.

    Economics of Education Review, 30(1), 79-98.

Lee, J. (2012). College for all: Gaps between desirable and actual P–12 math achievement

    trajectories for college readiness. *Educational Researcher*, *41*(2), 43-55.

Long, M. C., Conger, D., & Iatarola, P. (2012). Effects of high school Course-Taking on

    secondary and postsecondary success. *American Educational Research Journal*, *49*(2),

    285-322.

Long, M. C., Iatarola, P., & Conger, D. (2009). Explaining gaps in readiness for college-level

    math: The role of high school courses. *Education Finance and Policy*, *4*(1), 1-33.

Lubienski, S. T., & Lubienski, C. (2006). School sector and academic achievement: A multilevel

    analysis of NAEP mathematics data. *American Educational Research Journal*, *43*(4),

    651-698.

Marini, J. P., Mattern, K. D., & Shaw, E. J. (2011). Examining the Linearity of the

    PSAT/NMSQT®-FYGPA Relationship. Research Report 2011-7. *College Board*.

Martinez, M., & Klopott, S. (2005). The link between high school reform and college access and

    success for low-income and minority youth. Washington, DC: American Youth Policy

    Forum and Pathways to College Network.

Maruyama, G. (2012). Assessing college readiness: Should we be satisfied with ACT or other threshold scores? *Educational Researcher, 41*(7), 252-261.

McCormick, N., & Lucas, M. (2011). Exploring mathematics college readiness in the United States. *Current Issues in Education, 14*(1).

McKelvey, S. P. (2006). The relationship between the Virginia Standards of Learning tests and the new PSAT/NMSQT.

Michael, K. Y., & Alsup, P. R. (2016). Differences between the sexes among Protestant Christian middle school students and their attitudes toward science, technology, engineering and math (STEM). *Journal of Research on Christian Education*, *25*(2), 147-168.

Milewski, G. B., & Sawtell, E. A. (2006). Relationships between PSAT/NMSQT scores and academic achievement in high school. Research Report 2006-6. *College Board*. Retrieved from https://research.collegeboard.org/sites/default/files/publications/2012/7/researchreport-2006-6-psat-nmsqt-scores-academic-achievement-high-school.pdf

Murnane, R. J. (1984). A review essay-comparisons of public and private schools: Lessons from the uproar. *The Journal of Human Resources*, *19*(2), 263-277.

Nankervis, B. (2013). Gender inequity in the National Merit Scholarship Program. *Journal of College Admission*, (219), 20-25.

National Assessment of Educational Progress. (2009). *High school transcript study 2009.* Retrieved from https://www.nationsreportcard.gov/hsts_2009/

National Assessment of Educational Progress. (2015). *2015| Mathematics & reading at grade 12*. Retrieved from https://www.nationsreportcard.gov/reading_math_g12_2015/

National Association of Colleges and Employers. (2017). Average starting salary for class of 2016 held steady. Retrieved from https://www.naceweb.org/job-market/compensation/average-starting-salary-for-class-of-2016-held-steady

National Center for Education Statistics. (2004). *Conditions of education 2004*. Washington, D.C.: U.S. Department of Education.

National Center for Education Statistics. (2005). Student achievement in private schools: Results from NAEP 2000-2005. NCES 2006-459. Retrieved from http://ezproxy.liberty.edu/login?url=https://search-proquest-com.ezproxy.liberty.edu/docview/62145796?accountid=12085

Neal, D. A. (1998). What have we learned about the benefits of private schooling?. *Economic Policy Review*, *4*(1).

Niederle, M., & Vesterlund, L. (2010). Explaining the gender gap in math test scores: The role of competition. *Journal of Economic Perspectives*, *24*(2), 129-44.

Pajares, F., & Miller, M. D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of educational psychology*, *86*(2), 193.

Parker, R. S., Cook, S., & Pettijohn, C. E. (2007). School choice attributes: Positioning a private school. *Services Marketing Quarterly*, *28*(4), 21-33.

Patterson, B. F., & Ewing, M. (2013). Validating the Use of AP® Exam Scores for College Course Placement. Research Report 2013-2. *College Board*.

Peterson, P. E., & Llaudet, E. (2007). The NCES private-public school study: Findings are other than they seem. *Education Next, 7*(1), 75-79.

Proctor, T. P., Wyatt, J., & Wiley, A. (2010). PSAT/NMSQT® indicators of college readiness. Research Report No. 2010-4. *College Board*. Retrieved from https://files.eric.ed.gov/fulltext/ED562858.pdf

Reilly, D., Neumann, D. L., & Andrews, G. (2015). Sex differences in mathematics and science achievement: A meta-analysis of National Assessment of Educational Progress assessments. *Journal of Educational Psychology*, *107*(3), 645.

Renaud-Dubé, A., Guay, F., Talbot, D., Taylor, G., & Koestner, R. (2015). The relations between implicit intelligence beliefs, autonomous academic motivation, and school persistence intentions: a mediation model. *Social Psychology of Education*, *18*(2), 255-272.

Richardson, C. C., Gonzalez, A., Leal, L., Castillo, M. Z., & Carman, C. A. (2016). PSAT component scores as a predictor of success on AP exam performance for diverse students. *Education and Urban Society*, *48*(4), 384-402.

Romero, C., Master, A., Paunesku, D., Dweck, C. S., & Gross, J. J. (2014). Academic and emotional functioning in middle school: the role of implicit theories. *Emotion*, *14*(2), 227.

Royster, P., Gross, J., & Hochbein, C. (2015). Timing is everything: Getting students back on track to college readiness in high school. *High School Journal*, *98*(3), 208-225.

Sciarra, D. T. (2010). Predictive factors in intensive math course-taking in high school. *Professional School Counseling, 13*(3), 196-207.

Sparks, S. (2013). Growth mindset's gaining traction as school improvement strategy. *Education Week*, *33*(3), 1.

Spielhagen, F. R. (2006). Closing the achievement gap in math: Considering eighth grade Algebra for all students. *American Secondary Education*, *34*(3), 29-42.

Starr, C. R., & Zurbriggen, E. L. (2017). Sandra Bem's gender schema theory after 34 years: A review of its reach and impact. *Sex Roles*, *76*(9-10), 566-578.

Tsui, L. (1999). Courses and instruction affecting critical thinking. *Research in Higher Education*, *40*(2), 185-200.

Tyson, W., & Roksa, J. (2017). Importance of grades and placement for math attainment. *Educational Researcher*, *46*(3), 140-142.

U.S. Department of Education. (2010). *ESEA blueprint for reform: The reauthorization of the elementary and secondary education act.* Retrieved from http://www2.ed.gov/policy/elsec/leg/blueprint/blueprint.pdf

Warner, R. M. (2008). *Applied statistics: From bivariate through multivariate techniques.* Thousand Oaks, CA: Sage Publications, Inc.

van Rooij, E. C. M., Jansen, E. P. W. A., & van de Grift, W. J. C. M. (2017). Factors that contribute to secondary school students' self-efficacy in being a successful university student. *Research in Post-Compulsory Education*, *22*(4), 535-555.

Wighting, M., Nisbet, D., & Spaulding, L. (2009). Relationships between sense of community and academic achievement: A comparison among high school students. *International Journal of the Humanities*, *7*(3), 63-72.

Wiley, A., Wyatt, J., & Camara, W. J. (2011). The development of a multidimensional college readiness index. Research Report 2010-3. *College Board*. Retrieved from https://research.collegeboard.org/sites/default/files/publications/2012/7/researchreport-2010-3-development-multidimensional-college-readiness-index.pdf

Wolf, P. J. (2014). Comparing public schools to private. *Education Next, 14*(3).

Wulff, M. B., & Steitz, J. A. (1997). Curricular track, career choice, and androgyny among

    adolescent females. *Adolescence, 32*(125), 43.

Wyatt, J. N., Wiley, A., Camara, W. J., & Proestler, N. (2011). The development of an index of

    academic rigor for college readiness. Research Report No. 2011-11. *College Board*.

    Retrieved from http://files.eric.ed.gov/fulltext/ED561023.pdf

Wyatt, J., Smith, K., & Proestler, N., (2014). The benefits of early engagement in the college-

    preparation process: Implications for practitioners. Research Report 2014-1. *College

    Board.* Retrieved from http://www.research.collegeboard.org/publications/benefits-early-

    engagement-college-Preparation-process-implications-practitioners

Yeager, D. S. & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe

    that personal characteristics can be developed. *Educational Psychologist, 47*(4), 302-314.

Zhang, X., Patel, P., & Ewing, M. (2014). AP® Potential Predicted by PSAT/NMSQT® Scores

    Using Logistic Regression. Statistical Report 2014-1. *College Board*.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in

    mathematical, scientific, and technological careers. *American Educational Research

    Journal*, *37*(1), 215-246.

APPENDIX A: School Permission

RE: ☐ Data request for dissertation

Sun 4/7/2019 12:23 PM

To: Perdue, Christina Marie (Online Academy)

Approved.

Head of Schools

Academy

APPENDIX B: IRB Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

May 15, 2019

Christina M. Perdue
IRB Application 3803: The Differences between College Readiness and the Rigor of Algebra 1 Course Taken By Male and Female Students Attending a Private School in Southwestern Virginia

Dear Christina M. Perdue,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Your study does not classify as human subjects research because it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued non-human subjects research status. You may report these changes by submitting a new application to the IRB and referencing the above IRB Application number.

If you have any questions about this determination or need assistance in identifying whether possible changes to your protocol would change your application's status, please email us at

Sincerely,

LIBERTY
UNIVERSITY.
Liberty University | Training Champions for Christ since 1971