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John M. Grubb

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Dual Enrollment and Community College Outcomes for First-Time, Full-Time Freshmen:

A Quasi-Experimental Study

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A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment of the

requirements for the degree

Doctor of Education in Educational Leadership

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by

John M. Grubb

December 2015

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Dr. Pamela H. Scott, Chair

Dr. Donald W. Good

Dr. Richard E. Osborn

Dr. Cynthia S. Smith

Keywords: Dual Enrollment, Community College, Propensity Score Matching

## ABSTRACT

Dual Enrollment and Community College Outcomes for First-Time, Full-Time Freshmen:

A Quasi-Experimental Study

by

John M. Grubb

The purpose of this study was to explore the relationship of dual enrollment course participation by comparing first-time, full-time traditional community college students who participated in dual enrollment ( $N=246$ ) to peers ( $N=986$ ) that did not participate. Dual enrollment participation was defined as taking one or more dual enrollment courses. The population for this study ( $N=1,232$ ) included first-time, full-time students who graduated from public high schools in the service area of Northeast State Community College over a five year span from 2008 through 2012. Propensity score matching eliminated self-selection bias by controlling for confounding covariates such as parental education, high school GPA, and ACT scores.

The major findings of the study included the following: dual enrollment participants (a) were nearly four times less likely to take remediation than non-participants, (b) earned approximately 1 extra credit hour in the first semesters of college, (c) earned higher first semester GPAs, (d) were 2.5 times more likely to graduate in 2 years (100% of degree time) and, (e) were 1.68 times more likely to graduate in 3 years (150% of degree time). The study concluded that dual enrollment benefits community college students in Tennessee, both at the beginning and completion of college. This is a significant justification for the current investment in dual enrollment by the State of Tennessee and for further increasing access to dual enrollment for all students, especially for students that live in rural areas, experience poverty, or are underrepresented in higher education.

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## DEDICATION

Soli Deo Gloria

For my loving wife, Tina, and our beloved daughter, Hannah

My daughter began 3rd grade as I began this program in the fall of 2012. When she learned that I was in school, she made me an offer: "Daddy, if you need any help with your homework - let me know." Although I did do all my own homework, words fail to express how I have been helped by my wife and daughter not only through this program of study but also through life.

## ACKNOWLEDGMENTS

I would like to acknowledge the work of my committee. Dr. Pamela Scott has made the process a joy through her steady hand and timely advice. Dr. Donald Good has encouraged me through several consultations and copious annotations to the manuscript. Dr. Smith has generously shared her own work on the administrative side of dual enrollment and has given helpful advice for the process. Dr. Richard Osborn has helped me to refine my understanding of the study through his questions in committee. To all of you, my heartfelt thanks belongs.

I would also like to acknowledge other faculty at ELPA who have played a major role in this study. Dr. James Lampley has provided guidance and insight which helped to kick start this study. Dr. Louise Dickson provided a stimulating initiation into the APA writing style and literature reviews which led to the conception of this study.

I would like to acknowledge the assistance of Research, Analytics, and Planning at Northeast State under the leadership of Dr. Susan Graybeal for easing my way into research. Most especially thanks to the Director of Research and External Reporting, Connie Church, for helping me to understand the data and providing me the opportunity to discuss the minute details of the data over the last several months.

I would like to acknowledge the comradery of the Targeted Leadership Development Program participants and their role in my professional development - particularly the friendship of my companions in the Year 2 Project process, Dr. J. Michael Ramey and Erika Adams.

Finally, I have been blessed to work in the Wayne G. Basler Library for over 15 years to date. I would like to acknowledge the warm friendships and support that have been given to me by the staff of the library.

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## CHAPTER 1

### INTRODUCTION

The National Center for Education Statistics (NCES) has defined dual enrollment as “high school students earning college credits for courses taken through a postsecondary institution” (Marken, Gray, & Lewis, 2013, Appendix C, p. C-3). The credits may be earned through a formal cooperation of institutions, called a dual enrollment program, or through the student being admitted to college classes individually. Unlike other possible paths to college credit in high school, such as Advanced Placement (AP) or International Baccalaureate (IB) classes, dual enrollment offers actual college courses (Karp, Calcagno, Hughes, Jeong, & Bailey, 2007). In most of the literature, dual credit is defined as a specific arrangement within dual enrollment parameters by which high schools award credit for college coursework (Waits, Setzer, & Lewis, 2005).

The prototype of dual enrollment began at Syracuse University (McMannon, 2000). Project Advance was created at the request of nine nearby high schools for students who had completed the high school curriculum early (Anson, 2010). Syracuse University consented to pilot a series of courses for advanced students in 1973-1974 (Diamond & Holloway, 1975). The following year, the program was expanded to more than 40 high schools and served more than 2,000 students. Throughout the next three decades dual enrollment opportunities increased as state laws and policies progressed and programs were undertaken (Andrews, 2000).

National attention was brought to dual enrollment during a preliminary analysis of a nationally representative sample of students, which were tracked from 1988 through 2000 – a data set called the National Educational Longitudinal Study 88/2000 (NELS:88/2000) (Adelman,

1999). Even so, Andrews (2000) reported that dual enrollment statistics were still not widely collected or studied, although he predicted that substantial growth of offerings had already occurred. He inferred this growth from statistics of part-time enrollments by students under 18 (Andrews, 2000). In 1993, there were 96,913 part-time enrollments by students under 18; by 1995 there were 123,039. Andrews (2000) also reviewed state laws beginning in the 1980s and proceeding through the 1990s from around the nation which allowed and sometimes mandated dual enrollment opportunities.

The first national surveys of dual enrollment prevalence were published by the National Center for Education Statistics in 2005 (Swanson, 2008). The U. S. Department of Education reported that 813,000 high school students took dual enrollment classes in the 2002-2003 school year with over 95% of public two-year colleges and 83% of public four-year colleges participating (Kleiner & Lewis, 2005). The percentage of high schools participating in programs that offered dual credit courses was 71% with duplicated enrollments of 1,162,000 students (Waits et al., 2005). In total, almost 2,000,000 high school students were earning college credit through coursework in 2002-2003.

When the National Center for Educational Statistics again surveyed the nation regarding dual enrollment eight years later, there had been an incredible growth. By the 2010-2011 academic year the number of dual enrollment students increased to 1,363,500 with over 98% of public two-year colleges and 84% of public four-year colleges participating (Marken et al., 2013). The percentage of high schools participating in programs that offered dual credit courses had risen to 82% (Thomas, Marken, & Gray, 2013). Duplicated dual credit enrollments had grown to 2,036,700 students. The combined count of high school students earning college credit through coursework was 3,400,000, an increase of over 50% in 8 years.

According to Karp, Hughes, and Cormier (2012), dual enrollment helps students to succeed in college. Dual enrollment programs enable current high school students to take college classes and receive credit both for high school and for college (Community College Research Center (CCRC), 2012). High school students benefit from dual enrollment by experiencing the academic rigor of college level work and by accumulating credits that count toward completion. Studies by the CCRC demonstrated statistically significant positive outcomes for dual enrollment students including postsecondary enrollment, pursuit of a bachelor's degree, persistence to the second term and persistence to the second year. Many of these benefits also extend to career and technical pathways. Studies have shown that college students who are most disadvantaged (male, low income, and low achieving) experience the largest increases in GPA among dual enrollment participants.

Educational attainment correlates positively with high individual per capita income (THEC, 2014a). Tennessee ranked 43<sup>rd</sup> among the states for educational attainment in 2012. In 2013, 69,641 Tennessee students took the ACT (2014). Of those, 85% (59,160) reported an aspiration to attend college, yet only 56% (38,976) enrolled (ACT, 2014). The remaining 20,275 students who reported aspiring to college did not enroll in college after graduation. This is surprising given the success of Tennessee in secondary completion rates, which have exceeded the Southern Regional Education Board (SREB) and national secondary completion rates in recent years (THEC, 2014a), including all minority groups. Furthermore, Tennessee has recently ranked 23<sup>rd</sup> among the states for high school graduates for the Chance for College metric. Additionally, Tennessee has had a positive rise in educational levels regarding in- and out-migration patterns, meaning that the educational level of those entering the state is higher than those leaving the state, yielding a net benefit. Yet, despite all these positive trends, educational

attainment in Tennessee remains comparatively low. Following this trend, while per capita income in Tennessee has risen, it still lags SREB peers and the nation significantly.

### Statement of the Problem

With the situation of Tennessee reported above along with the purported benefits of dual enrollment participation, dual enrollment should be seen as an important tool in raising educational attainment and securing economic prosperity. Yet, the growth of dual enrollment has outpaced the understanding of its effects upon student outcomes. The efficacy of dual enrollment has not been well established in spite of its growth and popularity (Karp et al., 2007). Attempts at the assessment of dual enrollment typically fail to convince researchers because of a lack of comprehensive data or the application of rigorous statistical methods. An (2013a) observed that research on the impact of dual enrollment was still in its early stages and that attention to confounding factors lacked consistency. Comparisons in the literature make it clear that de facto standards regarding datasets for dual enrollment have not emerged. Neither have statistical methods been codified by which an authoritative analysis would be ascertained. Methods have ranged from chi-square and t-tests comparing populations only by treatment and outcomes (Thacker, 2014) to complex formulas using linear regressions (Karp et al., 2007; Swanson, 2008), and discontinuity regressions (Speroni, 2011a; 2011b). More recently, several dissertations and articles have analyzed large datasets which have used propensity score matching to create quasi-experimental groups for statistical comparison (An, 2013a; 2013b; Giani, Alexander, & Reyes, 2014; Kanny, 2014; Struhl & Vargas, 2012).

Therefore, the purpose of this study was to explore the relationship of dual enrollment course participation by comparing first-time, full-time traditional community college students

who participated in dual enrollment to peers that did not participate in dual enrollment. For the purpose of this study, dual enrollment participation was defined as taking one or more dual enrollment courses. Impact was assessed by measurable outcomes: remediation rates, number of credits earned in the first semester, comparisons of first semester and first year grade point averages, persistence to the second year, final college GPA, and completion rates in 2 years and 3 years. Propensity score matching was utilized to control for extraneous variables (An, 2013a; 2013b; Giani et al., 2014; McMillan & Schumacher, 2010; Struhl & Vargas, 2012).

### Research Questions

- RQ1: Is there a significant difference in the rates of remediation during the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment?
- RQ2: Is there a significant difference in the number of credit hours earned in the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment?
- RQ3: Is there a significant difference in the first semester grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment?
- RQ4: Is there a significant difference in the first year grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment?



- RQ5: Is there a significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment?
- RQ6: Is there a significant difference in the cumulative grade point averages at completion of college between students who participated in dual enrollment and students who did not participate in dual enrollment?
- RQ7: Is there a significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment?
- RQ8: Is there a significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment?

#### Significance of the Study

This study is significant in two ways. The first point of significance is as a contribution to the literature of dual enrollment. Ninety-eight percent of public two-year colleges offer dual enrollment courses (Marken et al., 2013). While the majority of dual enrollment students matriculate to four-year institutions, a large minority continue on to community colleges. The vast majority of dual enrollment literature addresses student outcomes at four-year institutions. This study also addresses potential short term benefits of dual enrollment such as remediation rates as a measure of college readiness and college credits earned in the first semester as well as potential long term benefits by following students to completion with several measurements selected to gauge the impact of dual enrollment.

The second point of significance is as a confirmation that dual enrollment contributes to the completion agenda in Tennessee. By 2020, 65% of jobs in the United States are expected to require a postsecondary credential (Carnevale, Smith, & Strohl, 2013). Many states are now setting numeric goals for postsecondary attainment (Collins, 2006). The political leadership of Tennessee accelerated the reform of higher education with the Complete College Tennessee Act of 2010, which initiated outcomes-based funding to explicitly establish a public agenda tying higher education to the workforce needs of the state (Tennessee Higher Education Commission, n.d.). The political leadership in the State of Tennessee has continued educational reforms by establishing a series of programs to help the state achieve a 55% postsecondary achievement rate by 2025 (Drive to 55 Alliance, 2014).

The political leadership of Tennessee has invested substantially in dual enrollment. In 2005, the Tennessee legislature approved using lottery monies to fund dual enrollment grants to encourage student participation (Columbia State Community College, n.d.). Between 2005 and 2012 academic years, dual enrollment participation more than tripled, growing from 5,465 to 17,759 student enrollees (THEC, 2012; 2014b). The initial grant structure provided \$300 for one course per semester (Motlow State Community College, n.d.). In 2011, lawmakers doubled the grant to include a second \$300 grant per semester for students who were Hope scholarship eligible, providing \$1,200 for the first four courses.

Tennessee must have more students prepared academically, enabled financially, and willing to enroll in postsecondary education (Karp, 2013). ACT (2013) has indicated that high school students taking advanced classes are far more likely to score college ready on the subject benchmarks, thus requiring less remediation. A vigorous curriculum during high school has been correlated with positive postsecondary outcomes (Adelman, 2006). In fact, a student's total

academic preparation prior to postsecondary enrollment can be used to predict postsecondary outcomes for that individual overcoming any statistical tendencies regarding the influence of race, gender, socioeconomic status, or family structure (Adelman, 2006).

Currently in Tennessee, the remediation rate for college freshmen entering straight from high school is 63% (THEC, 2014b). Of that cohort, only 68% will complete remediation work and finish college in 3 years. This rate is in stark contrast to Tennessee students who take dual enrollment coursework. Consider that among entering freshmen who are academically qualified for the Tennessee Educational Lottery Scholarship (TELS) 19% require remediation while only 12% of TELS recipients who participated in dual enrollment require remediation in college (THEC, 2012).

Given all the benefits listed in the introduction, it may be argued that dual enrollment should be an even higher priority in the completion agenda. By use of a rigorous statistical methodology, this researcher seeks to verify the extent to which benefits accrue to community college students in Tennessee, thereby justifying the continued investment of the state of Tennessee and growth of dual enrollment programs in Tennessee public high schools as a means of encouraging postsecondary participation and completion.

### Limitations and Delimitations

The first limitation of the study is a lack of experimental design. I will use a quasi-experimental quantitative methodology with a matched-sample design (McMillan & Schumacher, 2010). This statistical technique is called propensity score matching. The technique enables researchers to match each treatment case with one or more control cases based on a score created from covariates which express the likelihood or propensity of the participant

to choose treatment (Adelson, 2013). Matching the dual enrollment populations to the non-dual enrollment populations using covariates to create a quasi-experimental comparison may remove some participants from the treatment or control groups to achieve balance on covariates. The benefit of this technique is that extraneous variables like gender, previous academic ability, and many other potential confounding variables should be controlled during analysis (McMillan & Schumacher, 2010). Failure to account for observed covariates in voluntary program analysis is called self-selection bias and can skew the results of a study (Struhl & Vargas, 2012). Many dual enrollment programs require a high grade point average and may stipulate other prerequisites or tests before entrance so that typical participants are already well-supported and prepared for academic work (An, 2013b). Students who are affluent and more likely to attend college tend to take dual enrollment courses in greater numbers than students who are from lower socioeconomic homes (An, 2013a). The strength of propensity score matching lies in control of potential confounding factors in extraneous variables which are observed – thus controlling self-selection bias (Ho, Imai, King, & Stuart, 2007). However, it has limitations because it cannot balance for unobserved characteristics as a randomized experiment would (Joffe & Rosenbaum, 1999).

The second limitation is a lack of racial and ethnic diversity. The population will be first-time, full-time freshmen at a community college in Northeast Tennessee that graduated from public high schools in the service area and entered college the following fall. The population will be almost entirely in White. Thacker (2014) reported only 11 minority students out of 1,113 dual enrollment participants in her dissertation data, which covered academic years 2006-2009. This may limit generalization of the findings to more diverse populations.

A third limitation is controlling the class location within the design of the study. While most dual enrollment classes offered by Northeast State are held in the high school, some classes are delivered on a campus of the college (Gwen Widner, personal communication, January 29, 2015). There are disputes in the literature regarding the significance of course location. Speroni (2011a) determined that high school students in Florida who only took dual enrollment courses located at the high school campus had no better outcomes than students who took no advanced coursework, while students who took dual enrollment courses on the college campus did enjoy better outcomes than non-participating peers. Contrary to the findings of Speroni, Arnold (2015) found that performance of students in select courses of dual enrollment exceeded the performance of college freshmen in the same courses. An assessment of the relationship of dual enrollment course by specific location to outcomes will not be estimated in this study. In addition, some programs offer dual enrollment online as a third course location option; Northeast State Community College does not offer dual enrollment online (Dr. J. Michael Ramey, personal communication, May 21, 2015).

A fourth limitation regards the status of the instructor for the course. As with the variety in course location, there is variety in the status and experience of the instructor (Columbia University, 2012). Some dual enrollment courses are taught by tenured faculty, some by full time or part time adjunct faculty, yet others are taught by high school faculty. Critics of dual enrollment question the quality of instruction offered by adjunct faculty or high school teachers acting in an adjunct role in the same building in which they offer high school level courses (Crouse & Allen, 2014).

The study is delimited, prior to the propensity score matching procedure, to the population of first-time, full-time students who graduated from public high schools in the service

area of Northeast State Community College in May or June of a five year span from 2008 through 2012, then entered Northeast State Community College between June to September of the year of graduation seeking a two-year degree. The students who began college in the summer immediately after graduation were not required to be full time for that semester, but were required to be full-time for initial fall semester. All students in the population were also required to have completed the ACT and a FAFSA application. Therefore, results are not necessarily generalizable to other populations or settings.

### Definitions of Terms

Terminology surrounding dual enrollment has varied in some instances, however, the definitions of dual enrollment given by the federal government and the state of Tennessee have remained equivalent over time. On the other hand, dual credit has had a different meaning at the federal level and in contrast to the state of Tennessee as shown below. No Tennessee dual credit statistics were included in the data and the literature for Tennessee dual credit was not included in the literature review because of that critical difference. Literature regarding dual credit fitting the federal definition was cited in the literature.

Award Amount: The amount of federal aid awarded to a student (Federal Student Aid, 2015).

Dual Credit (Federal definition): A college course taught by college faculty by which high school students earn both college credits and high school credits simultaneously. College credit may be awarded immediately or awarded upon enrollment at a specific institution after high school graduation (Waits et al., 2005).

Local Dual Credit (Tennessee): A local high school course which is aligned with a college course syllabus and taught by a high school teacher at the high school. The students may also be awarded college credit if they pass the course and successfully complete a challenge test for college credit. The credit is awarded by the college working in cooperation with the high school (Tennessee Department of Education, 2015).

Statewide dual credit (Tennessee): A local high school course with a challenge test created by a committee of high school teachers and college instructors at the state level. Any student who successfully completes the test earns credit that can transfer to any Tennessee public institution of higher education (Tennessee Department of Education, 2015).

Dual Enrollment (Federal): A college course taken by high school students who earn college credit either immediately or upon matriculation to a particular institution. The course may be taught at the high school or at a college, but must be taught by a college instructor. High school credit may or may not also be awarded (Kleiner & Lewis, 2005).

Dual Enrollment (Tennessee): A college course taken by high school students who earn college credit either immediately or upon matriculation to a particular institution. The course may be taught at the high school or at a college, but must be taught by a college instructor. High school credit may or may not also be awarded (Tennessee Department of Education, 2015).

Dual Enrollment Program (Tennessee): An operational agreement between a high school and college that allows the student to take a college course and earn both college and high school credit toward both a high school diploma and a college degree or certificate simultaneously (Public Chapter 967, 2012).

Educational Attainment: The highest level of education completed by an individual (Educational attainment, 2015).

Expected Family Contribution (EFC): The amount of financial obligation which a family should contribute for a college education based on the family income and demographics. The higher this number the lower the amount of federal aid awarded (Federal Student Aid, 2015).

FAFSA: A form provided without charge for students to apply for federal aid to attend college (Federal Student Aid, 2015).

Federal Pell Grant: A grant from the federal government to help students attend college (Federal Student Aid, 2015).

Parental Educational Attainment: The highest level of education completed by the parent or guardian of a child. Parental educational attainment is a key indicator which correlates with several measures of well-being in children (Parental education, 2015) including the socioeconomic identity and educational attainment of the children (An, 2013b).

Propensity Score Matching: A quasi-experimental quantitative methodology which assigns a score to participants in an observational study which assesses the likelihood of voluntary participation using a linear regression. With that score the research is able to statistically balance the observed covariates in both the treatment and control groups to create a quasi-experimental study. Balancing the covariates eliminates self-selection bias from the study (McMillan & Schumacher, 2010).

Remediation: For the purpose of this study, remediation refers to any preparatory course taken in college to prepare the student for college level course work (Complete College America, 2012).



## Overview of the Study

This study is organized into five chapters. Chapter 1 includes an introduction to the study, a statement of the problem, the significance of the study, research questions, limitations and delimitations of the study, definitions of important terms, and an overview of the study. Chapter 2 consists of an extensive literature review regarding dual enrollment in the United States. Chapter 3 explains the research methodology for the study. Chapter 4 reports the analysis and interpretation of the data. Chapter 5 contains a summary, conclusions, implications of the results, and recommendations for future research.

## CHAPTER 2

### LITERATURE REVIEW

#### Introduction

The National Center for Education Statistics (NCES) has defined dual enrollment as “high school students earning college credits for courses taken through a postsecondary institution” (Marken et al., 2013, Appendix C, p. C-3). The credits may be earned through a formal cooperation of institutions, called a dual enrollment program, or through the student being admitted to college classes individually. Unlike other possible paths to college credit in high school, such as Advanced Placement (AP) or International Baccalaureate (IB) classes, dual enrollment offers actual college courses (Karp et al., 2007). In most of the literature, dual credit is defined as a specific arrangement within dual enrollment parameters by which high schools award credit for college coursework (Waits et al., 2005).

The prototype of dual enrollment began at Syracuse University (McMannon, 2000). Project Advance was created at the request of nine nearby high schools for students who had completed the high school curriculum early (Anson, 2010). Syracuse University consented to pilot a series of courses for advanced students in 1973-1974 (Diamond & Holloway, 1975). The following year, the program was expanded to more than 40 high schools and served more than 2,000 students. Throughout the next three decades dual enrollment opportunities increased as state laws and policies progressed and programs were undertaken (Andrews, 2000).

National attention was brought to dual enrollment during a preliminary analysis of a nationally representative sample of students, which were tracked from 1988 through 2000 – a data set called the National Educational Longitudinal Study 88/2000 (NELS:88/2000) (Adelman,

1999). Even so, Andrews (2000) reported that dual enrollment statistics were still not widely collected or studied, though he predicted that substantial growth of offerings had already occurred. He inferred this growth from statistics of part-time enrollments by students under 18. In 1993, there were 96,913 part-time enrollments by students under 18; by 1995 there were 123,039. Andrews also reviewed state laws beginning in the 1980s and proceeding through the 1990s from around the nation which allowed and sometimes mandated dual enrollment opportunities.

The first national surveys of dual enrollment prevalence were published by the National Center for Education Statistics in 2005 (Swanson, 2008). In 2005, the U. S. Department of Education reported that 813,000 high school students took dual enrollment classes in the 2002-2003 school year with over 95% of public two-year colleges and 83% of public four-year colleges participating (Kleiner & Lewis, 2005). The percentage of high schools participating in programs that offered dual credit courses was 71% with duplicated enrollments of 1,162,000 students (Waits et al., 2005). In total, almost 2,000,000 high school students were earning college credit through coursework in 2002-2003.

When the National Center for Educational Statistics again surveyed the nation regarding dual enrollment 8 years later, there had been an incredible growth. By the 2010-2011 academic year the number of dual enrollment students increased to 1,363,500 with over 98% of public two-year colleges and 84% of public four-year colleges participating (Marken et al., 2013). The percentage of high schools participating in programs that offered dual credit courses had risen to 82%. Duplicated dual credit enrollments had grown to 2,036,700 students. The combined count of high school students earning college credit through coursework was over 3,400,000, an increase of over 50% in 8 years.

According to Karp et al. (2012), dual enrollment helps students to succeed in college. Dual enrollment programs enable current high school students to take college classes and receive credit both for high school and for college (Community College Research Center (CCRC), 2012). High school students benefit from dual enrollment by experiencing the academic rigor of college level work and by accumulating credits that count toward completion. Studies by the CCRC demonstrated statistically significant positive outcomes for dual enrollment students including postsecondary enrollment, pursuit of a bachelor's degree, persistence to the second term and persistence to the second year. Many of these benefits also extend to career and technical pathways. Studies have shown that college students who are most disadvantaged (male, low income, and low achieving) experience the largest increases in GPA among dual enrollment participants.

### Trends Driving Dual Enrollment

Two recent trends within American education converge in dual enrollment programs (Karp et al., 2007). The first strives to increase rigor in secondary education; the second seeks to strengthen the connection between secondary and postsecondary institutions. Both of these trends were emerged from the failure of students to succeed in college. Policy makers and politicians have sought to satisfy both the trend to increase rigor in high school and the trend to connect secondary and postsecondary institutions through dual enrollment.

A reading of the literature reveals the need for increased rigor in secondary education. Many high school graduates are not prepared for college and require remediation (An, 2013a). Adelman (2006) presented an analysis of the National Education Longitudinal Study of 1988/2000 (NELS:88/2000), a nationally representative sample of students who were in the

eighth grade in 1988 and were tracked through 2000 with four additional surveys regarding their educational attainment. Adelman (2006) noted that a vigorous curriculum during high school correlated with positive postsecondary outcomes, yet impoverished schools serving low income and minority populations lack advanced course offerings. It is not surprising then that researchers have discovered that only 26% of students from the bottom quartile of family income graduated with a college degree by the age of 25 (An, 2013a). In contrast, 59% of students from the top quartile earned a degree by 25. Students who do not have a college-educated parent were 36% less likely to have academic preparation necessary to be highly qualified for a four year institution, which was far less than the 64% rate of highly qualified students who do have a college-educated parent (An, 2013a). Adelman (2006) asserted that a student's total academic preparation prior to postsecondary predicted postsecondary outcomes for that individual more accurately than established statistical tendencies regarding the influence of race, gender, socioeconomic status, or family structure. Studies showed that dual enrollment prepares students for college by introducing college level coursework and, when taught by a college instructor or on a college campus, the culture of college as well (An, 2013a). Karp et al. (2007) cataloged a litany of benefits derived by high school students via dual enrollment, all of which are more meaningful to the disadvantaged than the affluent: increasing rigor in high school, assisting marginal student in fulfilling higher academic standards, adding depth and variety to smaller schools, increasing retention, raising awareness of possible careers, introducing students to the culture of college, and cutting the cost of college.

Further reflection on the literature similarly justifies strengthening the connection between secondary and postsecondary institutions. According to a recent national study, almost one third of entering freshmen were not prepared for college coursework (Bidwell, 2013). These

findings, however, were not new (Karp et al., 2007). Bidwell (2013) reported that only 26% of students taking the ACT in 2013 were college ready in science, math, English, and reading. State analyses within the same article specified that in Tennessee, less than one third were proficient in three or four of these essential subjects. Scholars at Complete College America (2012) stated that remediation in college has not been effective. Entering college unprepared affects minorities more than white students. Even high school students with good grades in college preparatory coursework have often needed remediation (National Center for Public Policy and Higher Education and the Southern Regional Education Board, 2012). Remediation is associated with a longer stay at college, decreased motivation, and non-persistence (Karp et al., 2007). As Andrews (2000) pointed out, "Dual-credit programs are one of the most meaningful ways that community colleges and secondary schools can build strong relationships" (p. 35)

Strong relationships between secondary and postsecondary institutions can be seen in a negative or positive light. Anson (2010) postulated a series of motives applying to higher education institutions for offering dual enrollment including recruitment of students to the institution offering credit, profit for the higher education institution from course tuition, savings to higher education by shifting some course costs to high schools, and coordination of curricula between high schools and colleges, however, Anson (2010) failed to provide motives for secondary institutions to encourage or allow dual enrollment opportunities and for the participating students and their families, nor did he account for the origin and growth of dual enrollment springing from secondary institutions. In contrast, Barnett and Kim (2014) list most of these same motivations in a positive light. The ultimate beneficiary must be the student, but it

would be unreasonable to demand that the sponsoring institutions forming this pipeline must cooperate to their detriment.

### Controversies Surrounding Dual Enrollment

Both critics and proponents of dual enrollment have speculated concerning the effect of dual enrollment. There have been controversies that can be categorized into four issues of contention. The issues are institutional funding, the status of high school teachers, the quality of college courses, and the effects upon students.

The first controversy regards institutional funding. It stands to reason that when high school administrators are called upon to be responsible for a student and to award credit for college coursework that the high school should also be funded. Experience shows that when high school students participate in dual enrollment to the detriment of the funding the high school, participation drops (Karp et al., 2012). Andrews (2000) reported that when Illinois double-funded dual enrollment, meaning that both the high school and the college were paid for student participation, there was an explosion of dual credit. Georgia serves as a recent example of this principle (Karp et al., 2012). Georgia lawmakers reduced from dual funding to only funding the college for dual enrollment in 2008. Participation across the state dropped 25% the next year and continued to decline for the following two years. In 2011, lawmakers restored double funding and dual enrollment increased rapidly.

The second controversy regards the status of the high school teacher. Dual enrollment can present a threat to instructors at the high school (Andrews, 2000). These threats from the well-qualified and experienced high school instructor losing the opportunity of teaching the better students to a fear among many teachers that dual enrollment will cause a reduction in the

workforce. This concern alone can account for the common practice that school systems exercise their own prerogatives to “cherry pick” the dual enrollment offerings to compensate for the high school’s space needs or staffing shortages, rather than engaging dual enrollment as a way to offer certificates or whole programs (personal communication, Matthew Delozier).

The third controversy regards the quality of the college course. Critics of dual enrollment have argued that course quality on the college campus may decrease in response to the presence of high school students (Giani et al., 2014; Speroni, 2011b). Proponents have countered that dual enrollment brought academic rigor in high school. In summary that dual enrollment has assisted marginal students in fulfilling higher academic standards, added depth and variety in smaller schools, increased retention in high school, raised awareness of possible careers, introduced students to the culture of college, and cut the cost of college through the accumulation of credit prior to matriculation (Adelman, 2006; Giani et al., 2014; Karp et al., 2007). When high school teachers are employed by the college to teach dual enrollment, there is also a question about the quality of instruction suffering because the teacher is acclimated to the high school even if qualified for college instruction (Speroni, 2011b). States have responded to criticisms of dual enrollment by passing laws and regulations (Andrews, 2000). Leading states in this quality assurance effort included Florida, Illinois, Missouri, North Dakota, and Virginia. These states passed standards regulating course offerings, course location, program structure, and faculty qualifications.

The fourth controversy regard the effects of dual enrollment on the students. Critics have argued that dual enrollment participation mainly benefited affluent students who did not need additional preparation, and that the impact of the coursework could not be significant on postsecondary outcomes because of the self-selection of participants (Giani et al., 2014).



Speroni (2011b) delineated some objections to dual enrollment including the potential devastating effect of failure by students who are marginally prepared or motivated and the lowering of student aspirations to the community college level which is the level of most institutions offering dual enrollment programs. Proponents have countered by refining statistical analyses and seeking larger datasets. In refutation of at least one criticism, An (2013a) found that dual enrollment was not detrimental to low income students, refuting the charge that participation in dual enrollment is grossly unfair or counterproductive.

### Issues in the Analysis of Dual Enrollment

The efficacy of dual enrollment has not been well established in spite of its growth and popularity (Karp et al., 2007). Attempts at the assessment of dual enrollment typically fail to convince researchers because of a lack of comprehensive data or the application of rigorous statistical methods (Karp et al., 2007). An (2013a) observed that research on the impact of dual enrollment was still in its early stages and that attention to confounding factors lacked consensus. Comparisons in the literature make it clear that de facto standards regarding datasets for dual enrollment have not emerged. Neither have statistical methods been codified by which an authoritative analysis would be ascertained. Methods in this review ranged from chi-square and t-tests comparing populations only by treatment and outcomes (Thacker, 2014) to complex formulas using linear regressions (Karp et al., 2007; Swanson, 2008), discontinuity regressions (Speroni, 2011a; 2011b), and propensity score matching (An, 2013a, 2013b; Giani et al., 2014; Struhl & Vargas, 2012).

Researchers encounter three primary issues in assessing dual enrollment: the limitations of the dataset, the type of benefits examined, and self-selection bias. Limitations in the dataset

may predetermine what types of benefits may be examined and whether or not self-selection bias may be reduced.

### Dataset Limitations

Datasets vary in their size and depth and present challenges to researchers. The datasets used in studying dual enrollment have tended to be rather small and therefore did not yield findings that may be generalized to a whole population (Giani et al., 2014). Giani et al. asserted that the evidence for and against dual enrollment lacked authority, given the absence of experimental or quasi-experimental methodologies for analysis.

The samples in this literature review ranged in size from  $N=1,113$  (Thacker, 2014) to  $N=382,236$  (Giani et al., 2014). One sample did not include sufficient data to examine ethnicity (D'Amico, Morgan, Robertson, & Rivers, 2013). An (2013b) reported that the national dataset he used did not code whether a dual enrollment class took place in a high school or on a college campus, whereas Speroni (2011a, p. 25) used Florida state data that included the location of the class – and that distinction figured prominently in her findings.

### Types of Perceived Benefits

The benefits of dual enrollment fit into three possible categories: dual enrollment as a treatment, dual enrollment as a continuous variable, and the examination of specific subject areas for their effects on student outcomes in dual enrollment. The anticipation of a benefit preselects the statistical method used for analysis.

The first category consists of dual enrollment as a treatment. According to Giani et al. (2014), sociocultural benefits arose from the exposure of the student to the culture of higher education and did not necessarily continue to accrue with multiple classes and credits. There is

some support that the treatment requires two doses: An (2013a) found that taking one dual enrollment course had no effect on whether a student would complete a Bachelor's degree, but found that if a student earned 6 credit hours or more were 12% more likely to attain a bachelor's degree when compared to the whole population. The effect did not increase with additional hours beyond six credits. This partially supports and refutes Adelman's (2006) 20 hour hypothesis and Swanson's 2008 "nest egg" theory (p. 82). These benefits of the dual enrollment treatment included a better understanding of expectations in higher education, removing the mystery of higher education (An, 2013a), and the formation of higher career aspirations. This approach ignored the effect of particular course subjects, rigor, location of class, instructor affiliation, and the credit accumulated by taking more than one dual enrollment course (An, 2013a).

The second category encompasses dual enrollment as a continuous variable. The benefits were the cumulated experiences of the classes and the advantages of carrying credits forward into college (Giani et al., 2014). Giani et al. concluded that the literature scarcely addresses dual enrollment cumulated effects.

The third category examines specific subject areas for their effects on student outcomes in dual enrollment. Adelman (1999) advocated using dual enrollment to provide the most rigorous kinds of coursework to less affluent high schools, because academic intensity led to higher rates of student success. For example, several researchers confirmed that dual enrollment in college level math correlated with the strongest outcomes (Giani et al., 2014; Speroni, 2011b; Struhl & Vargas, 2012). Regardless of the way in which dual enrollment was treated in various analyses, there continued to be a dearth of quantitative studies in the subject (Thacker, 2014).

A potential fourth category benefit, which the literature does not address, is the use of dual enrollment credits to deliberately take a decreased load early in college while adjusting to the culture and navigating the difficult gateway courses. I have two colleagues that have confirmed that this was how their children used dual enrollment credits during the freshman year (personal communication, Ginger Christian; personal communication, Cheri Gregory). Exploration of this use would require a qualitative approach to discover what would not be necessarily evidenced by a higher GPA, persistence, or swifter completion.

### Self-Selection Bias

Speroni (2011b) noted that there are two sources of selection that may skew the potential and real effect of dual enrollment. The first is selection criteria established by colleges. This is a necessary precaution to guard the integrity of any academic program. Unprepared students can derail a program and cause an unnecessary failure rate. Researchers cannot control for that source of selection.

The second source of selection is the choice of the student to take a dual enrollment class (Speroni, 2011b). This is termed self-selection. Students, or their guardians, may choose a course for a variety of reasons including their confidence in their own abilities, career aspirations, or a foreseen benefit of the course or its credit. There may also be encouragement from family, friends, or a mentor. An absence of any of the positive factors may prevent a student from enrolling in dual enrollment. The result is that many students do not select to take dual enrollment even though they could benefit from it academically and socially. The preponderance of students taking dual enrollment must meet the selection criteria of the program and have the wherewithal to enroll. This tendency to enroll by students that are already well-

prepared and supported can skew the assessment of what effect dual enrollment truly could have on all students.

An (2013a) noted that prior research on dual enrollment often failed to acknowledge and control self-selection. According to Struhl and Vargas (2012), comparing students without controlling for self-selection falsely portrays the effects of dual enrollment. As Struhl and Vargas observed, students with strong academic skills take dual enrollment classes, but those students are most likely to go to college and graduate whether dual enrollment is available or not. To compare all students in dual enrollment to the whole population would not reflect the true effect of dual enrollment on college outcomes.

After 2009, some researchers have used statistical methods to control for self-selection bias such as difference-in-difference design, regression discontinuity, and propensity score matching (An, 2009; Giani et al., 2014; Kanny, 2014; Speroni, 2011a; 2011b; Struhl & Vargas, 2014). However, a lack of control for self-selection bias continues to appear in recent research, such as that of D'Amico et al. (2013).

Many dual enrollment programs require a high grade point average and may stipulate other prerequisites or tests before entrance so that typical participants are already well-supported and prepared for academic work (An, 2013b). Students who are affluent tend to take dual enrollment courses in greater numbers than students who are from lower socioeconomic homes (An, 2013a). Eligible students may choose whether to participate in dual enrollment or not (Speroni, 2011b).

A major factor in academic preparation, the concept of socioeconomic status is complex and includes economic, cultural, and familial characteristics (Karp et al., 2007). The income and education of the parents, if known, help in assessing this status. Karp et al. (2007)

measured socioeconomic status by eligibility for free or reduced lunch programs; An (2013b) measured socioeconomic status by parental educational attainment.

Data provided by the Tennessee Higher Education Commission (THEC) (2012) verified that parental educational attainment was a major factor in use of the dual enrollment grant. Between 2005-2006 and 2009-2010, 99% of all dual enrollment grant scholarships were used by students with at least one parent with an associate's degree or more education. This is in stark contrast to students receiving a Tennessee Educational Lottery Scholarship award, where about 63% of awards are given to students with at least one parent with an associate's degree or more. This trend supports the proposition that parental educational attainment is strongly correlated with the academic preparation of students. Of the students using the dual enrollment grant 65% came from households with an annual income of \$48,000 or more and nearly 30% of the recipients were from households with an annual income over \$96,000. Though the state administrators see dual enrollment as a premium opportunity for underrepresented groups to explore college early and have a college experience – families, particularly low socioeconomic families, are not leveraging dual enrollment opportunities.

Socioeconomic boundaries are also highly correlated with race. In 2012, the population of Tennessee demographically was White/Caucasian (67.1%), Black (19.8%), Asian (1.7%), Hispanic (8.0%), and Other (3.5%) (THEC, 2014a). The population of Tennessee has aged over the last twenty years and the youth have become more diverse ethnically. Long-term projections predict a slow increase in each of the minority racial groups proportional to the White majority. The percentage of participation in college by each minority group (excepting Asians at 74%) lags the participation of the White majority (61%). Although the small Hispanic population has made progress (from 35% to 42%), Blacks have remained at a participation rate about 50%. The

participation rate, however, only shows part of the story, retention rates for Blacks are lower than Whites by significant amounts - 6% lower at 4 year institutions and 16% lower at community colleges. Completion rates of Black students lag White students by about 18% at both 2- and 4-year state institutions (THEC, 2014a). This rate is reflected in the dual enrollment grant usage, with Blacks receiving 9% of dual enrollment grant monies and 10% lottery scholarship monies at college entry compared to White students utilizing about 80% of the dual enrollment grant monies and 85% of the college scholarship monies (THEC, 2012).

In regard to low income participation, Tennessee has a 34.2% college participation rate among low income families, nearly double the participation rate in 2000 for the state (THEC 2014a). This rate has exceeded the SREB average of 33.1%, but continues to lag the national average participation rate of 39.4%. Despite Tennessee being ranked 3<sup>rd</sup> in the nation for grant in aid to students, only 22% of that aid is given to low income students, which pales compared to the SREB peers (39%) and the federal government (74%).

In regard to citizens living in rural counties, there is also disadvantage. Participation in dual enrollment and use of the dual enrollment grant is strongly correlated with attending a high school near a participating institution (THEC, 2012), thus rural counties are at a disadvantage to offer dual enrollment. Admittedly, these students are more likely to also be low income, but this would also affect middle and upper socioeconomic class students in rural counties.

All of the above factors: parental educational attainment, race, low-income, and living in rural areas affect the availability of dual enrollment or the willingness of students to participate in dual enrollment programs. These factors would skew any analysis of dual enrollment that did not control for appropriate covariates.

### Chronological Review of Significant Research

National attention regarding educational strategy and outcomes using dual enrollment intensified through the work of Adelman (1999, 2006). Adelman (2006) offered the first in-depth analysis of the NELS:88/2000, a nationally representative sample of students who were in the eighth grade in 1988 and were tracked through 2000 with four additional surveys regarding their educational attainment. Adelman did not focus the study on dual enrollment. Data on dual enrollment participation began to be collected systematically after the turn of the millennium (Karp et al., 2007). National Center for Education Statistics initially measured the prevalence of dual credit and dual enrollment throughout the United States in 2005 (Swanson, 2008). That initial measurement showed that over half of the 4,000 responding institutions enrolled high school students to classes, both in and outside of dual enrollment programs. Yet, some of the recommendations of the study by Adelman (2006) did feature dual enrollment as an educational strategy. Adelman discovered that students who did not complete at least 20 credit hours by the end of their first year in college were one third less likely to complete college. This threshold affected minorities disproportionately, therefore Adelman recommended that high schools target populations through dual enrollment that were likely to fall short of the 20 hours.

The next year, Karp et al. (2007) published a research article that assessed dual enrollment effects on differing socioeconomic status. The researchers analyzed datasets from the state of Florida ( $N=299,685$ ) and New York City ( $N=2,303$ ). The New York City data included only those students who attended one of nineteen vocational high schools and continued on to the City University of New York (CUNY). The data from New York City was so selective that the comparison with the statewide Florida sample seems hardly justified. Karp et al. (2007) were careful to note that their analyses should be received with caution because of the difficulty in



controlling covariates. Nevertheless, this paper served as an early exemplar of attempting control for self-selection and examining socioeconomic status (An, 2013a) by using more advanced statistical methods (ordinary least squares and logistic regressions (Karp et al., 2007). Although Kanny (2014) would later state that these specific statistical methods in analysis yield “biased estimates of the treatment effect” (p. 81)

The concept of socioeconomic status included economic, cultural, and familial characteristics (Karp et al., 2007). Yet in this study, student eligibility for free or reduced price lunch programs alone justified classification as low socioeconomic status. Moreover the article presented the first separate analysis for the effects of career and technical education classes taken through dual enrollment.

The findings were significant. Dual enrollment correlated with a greater likelihood to finish high school (4.3%), begin college, have a higher grade point average, persist to the second year, accumulate more credits, and graduate. Though somewhat true in New York City, it was more so in Florida. The effects were stronger for students enrolled in career and technical education classes than for the general population. In the analysis of Florida data, males and low income students benefited more than the general population. The much smaller New York City dataset only allowed the conclusion that no significant differences based on gender existed. Karp et al. (2007) examined the data for cumulated benefits for multiple courses and uncovered none in Florida, while students in New York had better outcomes with two or more dual enrollment courses. Karp et al. suggested that eligibility requirements should be rethought and career and technical education dual enrollment should be expanded. In addition, the use of more advanced quasi-experimental techniques were endorsed to assess dual enrollment more accurately. As this literature review proceeds, the reader will find that has taken place.

Swanson (2008) followed Adelman (2006) using the NELS:88/2000. Swanson examined the longitudinal data specifically for the effects of dual enrollment, particularly looking at retention and completion. The national dataset did not separate the various settings for dual enrollment, so some ambiguity persisted in spite of vigorous assessment.

Swanson (2008) found that dual enrollment students were 11% more likely to persist through the second year of college than non-participating students. Dual enrollment students were 12% more likely to enter college within seven months of high school graduation than non-participating students. Finally, dual enrollment students who completed 20 or more credits in the first year of college were 28% more likely to persist through the second year in college than were students who did not complete dual enrollment courses.

Swanson (2008) built on Adelman's 2006 discovery of the 20 hour threshold. Swanson incorporated this "nest egg" of credit (p. 82) with two other factors: enrollment in college no more than seven months after graduation and persisting through the second year of college with no more than one semester of not taking classes. These three markers together comprised academic momentum. Students who participated in dual enrollment maintained academic momentum at a significantly higher rate. That rate remained unaffected by demographic and academic characteristics of students except for males and Hispanics, who were actually less likely to attend four-year institutions and less likely to persist and complete their academic program.

An (2009) also used the NELS 88/2000 dataset to examine the effects of dual enrollment on outcomes in college and overall educational attainment, though without acknowledging or citing Adelman (2006) or Swanson (2008). This was the first dissertation - and may have been the first analysis - concerning dual enrollment using propensity score matching to control for

confounding variables. An (2009) demonstrated the refining power of controlling for confounding covariates by analyzing for effects prior to and after matching. An estimated that observed characteristics accounted for anywhere from 36 to 83 percent of the reported benefit of dual enrollment for students, yet even after removing that exaggerated effect dual enrollment was significantly correlated with better outcomes during college regarding persistence and completion.

The findings regarding short and mid-range outcomes were significant. An (2009) found that dual enrollment students were 7% less likely to need remediation. An's analysis of the effect on dual enrollment for first year GPA discovered that dual enrollment students had a 0.17 GPA advantage over their peers. Dual enrollment students earn about 10.8 more credit hours than non-participating peers over the course of a bachelor's degree. Approximately 4.2 of these credits were earned in college and the rest were dual enrollment credits - meaning that about 6 credit hours was the average.

The findings for long term outcomes were also significant. An (2009) discovered a reduction in time to degree of 1.1 months after matching, which was statistically significant but had a very moderate effect size. This was much less than Morrison's 2008 finding that each college credit hour earned in high school reduced time to degree by 78 days. An (2009) examined four categories regarding completion: time to degree (-0.16), time to Bachelors of Arts (-0.34), likelihood to earn any degree in 150% of stated degree time (0.08), and likelihood to earn a Bachelors of Arts in 6 years (0.05).

Speroni (2011a; 2011b) returned to the Florida dataset analyzed by Karp et al. (2007) and issued two separate articles with differing emphases. Covariates included demographic features like race, socioeconomic status, and eligibility for free or reduced lunch as well as characteristics

of the schools attended and the academic performance of the student as pictured in GPA and standardized test scores. Both of the studies found dual enrollment to be positively correlated with almost all student outcomes that were assessed.

Speroni (2011b) introduced regression discontinuity, a quasi-experimental method, to the assessment of dual enrollment. Speroni explained regression discontinuity to be a method that simulated an experimental assessment in observational studies. Florida stipulated a minimum grade point average for a student to be eligible to take dual enrollment. Speroni leveraged this policy to identify quasi experimental groupings. Ineligible students, whose GPA was just below the cutoff point, comprised the control group; the students who were eligible by a narrow margin and took the class were the treatment group.

In the first article, Speroni (2011a) assessed data to compare AP and dual enrollment. The data came from an era in which many high schools and postsecondary institutions considered AP classes superior to dual enrollment when calculating grade point average, class rank, or in admissions. Speroni identified that AP held an advantage in enrollment at four-year institutions, particularly as the academic ability of students increased. Since 2006, Florida has required that AP and dual enrollment be weighted equally. This previous policy bias for AP could account for the finding that AP students were more likely to attend public in-state four-year institutions even though dual enrollment students attended public in-state colleges at greater rates than AP students. Speroni noted that AP and dual enrollment students attended private institutions or schools outside the state so that student outcomes were underestimated. Speroni determined that high school students who only took dual enrollment courses located at the high school campus had no better outcomes than students who took no advanced coursework, while

students who took dual enrollment courses on the college campus did enjoy better outcomes than non-participating peers.

In the second article, Speroni (2011b) contrasted an aggregate examination of all dual enrollment effects with the effect of a college-level algebra course noted for its rigor. Speroni noted that most prior studies of dual enrollment have used data coming from college transcripts. This meant that only those who matriculated were included in the data. Even that data may be skewed as dual enrollment credits get dropped or coded as transfer credits at a change in institutional enrollment. These data limitations may have introduced a bias in the selection of the sample. Although the data provided by Florida made it possible to identify the high school, the location of the course offering, and the course type, Speroni did not assess effects of course location in this article.

Speroni (2011b) discovered that the aggregate effect of dual enrollment on outcomes did not rise to significance. Given that the majority of dual enrollment participants were seniors meeting the 3.0 minimum grade point average, it is hardly surprising that Speroni explicated that dual enrollment made no significant difference in graduation rates from high school, nor did it have a significant effect on matriculation. The analysis of whether dual enrollment diverted students from four-year institutions to community colleges remained inconclusive and the effect on completion slightly negative, though insignificant. However, when examining a rigorous algebra class and the effect upon students just above the grade point average minimum, Speroni unearthed a large effect. This dual enrollment experience increased the likelihood of enrolling in college by 16% and the likelihood of finishing college by 23%.

Although Speroni (2011b) used the same data as Karp et al. (2007), the findings were not in harmony. Karp et al. (2007) included career and technical dual enrollment in the analysis and

concluded that dual enrollment benefited males and low income students in Florida. Speroni's (2011b) analysis, which excluded career and technical dual enrollment, focused on the grade point average margin and located no generic benefit.

In dissonance with Speroni's (2011b) negative findings about generic participation in dual enrollment, Struhl and Vargas (2012) positively stated that "...a growing body of research suggests that allowing students in high school to complete even a single college class could significantly increase their chances of attending college and eventually graduating" (p. v). Struhl and Vargas analyzed a dataset from the state of Texas that tracked the graduating class of 2004 through June of 2011. Texas stored data for course type and the amount of courses taken, but Texas did not code for the location of the course offering - whether at the high school or the college campus. The researchers expressed sensitivity to control for self-selection bias and utilized propensity score modeling.

Controlling for race and socioeconomic status, Struhl and Vargas (2012) elucidated that students who had taken a dual enrollment course were 50% more likely to complete a degree in six years than students who did not participate in dual enrollment. Additionally, the benefit of dual enrollment for low income students exceeded that for the general population of dual enrollment participants. Furthermore, dual enrollment students were more than twice as likely to go to an in-state college, twice as likely to continue on to the second year of college, and 1.7 times more likely to graduate college.

However, Struhl and Vargas (2012) did note differences of effect within racial and ethnic groups based on dual enrollment participation. First, White students and Hispanics who completed a dual enrollment course were 2.21 times more likely to enroll in college than those of the same race. Second, African Americans participants were 1.6 times more likely than their

peers to enroll in college. Third, low-income participants were 2.41 times more likely to enroll in college than low income students who did not participate in dual enrollment. Finally, students who were not economically disadvantaged were 2.03 times more likely to enroll at a four-year institution than similar peers.

Struhl and Vargas (2012) in like manner uncovered a difference in effect based on the dual enrollment course subject. On average, dual enrollment students were 2.21 times more likely to enroll, while students taking an English Language Arts course were 2.75 times more likely to enroll - above the average effect. At the same time, those dual enrollment students taking vocational, foreign language, and physical education were less likely to enroll than the average effect. Interestingly, math courses were not more or less indicative than the average effect – another differentiation from the findings of Speroni (2011b), who unearthed a very significant effect of a college algebra course on Florida students.

D'Amico et al. (2013) presented an analysis of South Carolina students with dual enrollment credits who continued on to a technical community college in the state system, focusing on student persistence from the first to second year. The variables considered in the study included gender, ethnicity, county of residence, the setting of the course, and the course type. The research question regarded the demographic and dual enrollment policy factors that were predictive on first-to-second year persistence. There were three key findings: 1) students from counties that were economically distressed persisted in college just as well as those from more affluent counties, implying that increasing dual enrollment may increase retention and success for students; 2) students taking career classes as opposed to transfer classes intended for a bachelor's degree were more likely to persist; and 3) taking the dual enrollment course on campus has the best effect on student outcomes.

The dataset used by D'Amico et al. (2013) had severe limitations. Though students were categorized according to the affluence of their county, their family resources and background were not considered. Standard grade point averages and standardized test scores were not in the data. Self-selection bias may have been a major contributor to this study yet it remained unacknowledged. The article featured a bibliography, which did include Karp et al. (2007), but omitted Swanson (2008) and listed no research after 2008.

An (2013a; 2013b) revisited dual enrollment after his 2009 dissertation and published two articles concerning dual enrollment and its effect on students with a low socioeconomic status. The analysis of the first article concerned two national datasets. The primary set was the National Educational Longitudinal Study (NELS:88/2000), used previously by Adelman (1999, 2006) and Swanson (2008). For comparison with a more contemporary dataset, though one with fewer pre-college covariates, the author selected the Beginning Postsecondary Students Longitudinal Study of 2004/09 (BPS:04/09). The data did not indicate the type, rigor, or setting of the dual enrollment credit earned. Propensity score modeling was the primary statistical method. An (2013a) delineated the limitations of prior research on dual enrollment: an emphasis on short or medium term effects on student outcomes, a failure to acknowledge and control self-selection bias, and failure to analyze outcomes for differing socioeconomic status.

Prior to matching procedures to control for self-selection bias, An (2013a) identified an advantage held by dual enrollment participants in the NELS:88/2000 data analysis: students who had at least 3 credit hours of dual enrollment credit were 7% more likely to earn bachelor's degrees and 8% more likely to earn any postsecondary credential when compared to students with no accelerated study. Results for students with AP classes as compared to results for students with dual enrollment credits were comparable. After matching procedures, An also



noted that taking one dual enrollment course had no significant effect on whether students would complete bachelor's degrees, but discovered that students who earned 6 or more credit hours were 12% more likely to attain bachelor's degrees when compared to the overall population. The effect did not increase with additional hours beyond six credits. First generation students were 8% more likely to earn postsecondary degrees if they participated in dual enrollment (An, 2013a). On the primary question of low socioeconomic status student benefit, An (2013a) found a small positive effect for low income students in dual enrollment, though students with low socioeconomic status would have to be the vast majority of participants in the program to offset the advantage held by those with higher socioeconomic status.

An (2013b) next examined dual enrollment to assess its effect on "academic performance and college readiness" (p. 407) in relation to socioeconomic status. An used a national dataset, Beginning Postsecondary Students Longitudinal Study (BPS:04/09), to assess if dual enrollment benefits low socioeconomic status students as well as higher socioeconomic status students. Though extensive the dataset was not coded to separate the location of dual enrollment classes or to examine classes based on the subject matter.

An (2013b) measured socioeconomic status by parental education because it had the largest influence on dual enrollment participation. An reviewed literature showing that parents with a low socioeconomic status tended to be passive in their children's curricular and educational choices whereas parents of a higher socioeconomic status were more involved by way of expectations and input. An pointed out that the choice of academic track, college or general, also had an impact on educational attainment.

An (2013b) measured college readiness by remediation. Twenty-eight percent of college freshman enrolled in a remedial course. Remediation delayed educational progress and signaled

a decreased completion rate. An measured academic performance using first-year grade point average. Along with a higher grade point average in high school dual enrollment participation correlated with a higher grade point average in college. Using propensity score matching to control for the covariates, An established that dual enrollment did benefit low socioeconomic status students that participated as much as students with a higher socioeconomic status, in regard both to first year college grade point average and bypassing remediation. Although the analysis demonstrated a benefit for students with a low socioeconomic status, parental education levels mitigated the effect.

Jorgensen (2013) evaluated the efficacy of a recent statewide dual enrollment program for impoverished students in Colorado created in 2009 by the Colorado General Assembly. The Concurrent Enrollment Programs Act expanded dual enrollment opportunities to all high school students in grades 9-12. Jorgensen focused on the effect of dual enrollment to create social capital for students living in poverty. Participation in free or reduced lunch programs (FRL) was the key indicator to living in poverty. In order to assess the efficacy of the expanded dual enrollment programs in the state, Jorgensen explored three areas of concern: participation of underprivileged students, high school outcomes, and outcomes for the first year of college. Jorgensen secured three years of data for analysis (2009-2010, 2010-2011, 2011-2012). The first year reporting omitted hours attempted and earned and was unusable.

The first category of inquiry for Jorgensen (2013), prior to the matching procedure, was participation of FRL students in dual enrollment. Were students in poverty adequately represented in the dual enrollment population? The comparison of participation rates from statewide for free or reduced lunch participants with those student who were not in the FRL program showed an underrepresentation of 3.7 percent. Reduced lunch students were

represented slightly above expectations, but free lunch students were underrepresented (-4.5%) when looking at the absolute population percentage. Even though FRL participants increased in number the second year, they decreased as a percentage of participants. The period of the study was during a transition from the previous dual enrollment program, Postsecondary Education Opportunities to the Concurrent Enrollment Programs, so conclusions about participation could not reveal the entire scope of dual enrollment at that time.

From the two years of usable data (2010-2011, 2011-2012) Jorgensen (2013) created three cohorts: CE1 contained the single year FRL high school students for 2010-2011, CE2 contained the single year FRL high school students for 2011-2012, and CE1/2 contained the FRL high school students taking dual enrollment in both years from 2010-2012. CE1 contained 2,157 dual enrollment participants and 7,034 non-participants. CE2 contain 3,472 dual enrollment participants and 10,448 non-participants, CE1/2 contained 699 dual enrollment participants and 2,405 non-participants. Jorgensen used propensity score matching to compare FRL students who participated in dual enrollment with FRL students who did not participate in dual enrollment.

The second area of investigation related to high school outcomes. Jorgensen (2013) discovered that FRL students attempted more dual enrollment credits but earned significantly fewer credits. FRL students were also more likely to take remedial courses, though not significantly so.

Jorgensen (2013) matched FRL dual enrollment students with FRL non-dual enrollment students and compared students in the years 2010-2011, 2011-2012, and a subset of 2010-11 who participated in dual enrollment both years. A sensitivity test to assess the likelihood of a unidentified confounding factor skewing results revealed no significant concerns. Although the specific effects varied between analyses, overall dual enrollment had a significant effect on math,

reading, and writing scores for the state assessment. Furthermore 2 cohorts earned significantly higher GPAs in high school, and first year college GPA was significantly higher for 2 of the 3 cohorts. Jorgensen also reported college-going rates, which were far higher for FRL students who participated in dual enrollment than FRL students who did not participate.

The findings of Jorgensen (2013) were congruent with other studies of dual enrollment. He refined the understanding of specific benefits during high school than most studies, though the relationship of participation to outcome was temporally compromised. Jorgensen cited the positive findings of his study as antecedent effects to the college success of low-SES students published by An (2013a) earlier that same year.

Kanny (2014) examined the role of dual enrollment on college engagement. The data were collected by the Center for Postsecondary Research (CPR) at Indiana University. Each year the CPR administers two annual surveys, the Beginning College Student Survey of Engagement (BCSSE) in the fall and the National Study for Student Engagement (NSSE) the following spring. The NSSE focuses on college experiences while the BCSSE focuses on high school experiences that prepared the students for college and the entering students' attitudes and expectations. The institutions that complete the surveys are randomly selected from participating institutions. These surveys are not distributed to be representative of the nation, tend to lack diversity, and poll more private institutions than a nationally representative study would include.

During the years 2005-2006 and 2006-2007, several institutions implemented both instruments creating a dataset that gave a longitudinal snapshot via the BCSSE of the entering freshmen in the summer or early fall semester and later the NSSE in the spring semester. These data contained responses from 44,752 students. The CPR allowed researchers to gain access to no more than a random sample of data up to 15% of the original dataset. This practice yielded

6,713 students prior to further dataset restrictions. Kanny (2014) required that each student included in the final data complete the questions concerning dual enrollment, be full-time first-year students, and matriculate to a four year institution without a break. These further restrictions shrunk the dataset to 4,724 students. About 75% (3,544) student did not participate in dual enrollment; about 25% (1,180) did participate in dual enrollment. After the matching procedure, the data contained 1,161 dual enrollment participants matched with 3,448 non-participants.

Although the matched sample was garnered from a random sample of students, there are reasons to question whether the sample is representative of all college students. First, the sample was entirely full-time traditional students at four year colleges. Second, the matched sample derived from multiple layers of purposeful and random sampling, which may have skewed the results. One indicator that the data was skewed was the acknowledgement of Kanny (2014) that the dual enrollment participation rate for the matched sample was three times the national average as reported by the NCES in 2010-2011. Some results from the research were contrary to accepted wisdom represented in all the research reviewed so far in this chapter as the discussion below will show. Kanny examined the data to answer 5 research questions examining effects by gender, first generation status, and secondary academic achievement.

Kanny's (2014) first research question asked whether dual enrollment participation could be predicted by student characteristics. The analysis concluded that gender, socioeconomic class, parental education, and other racial identities were not predictive of participation. However, identifying as multi-racial had a strong negative correlation with not participating in dual enrollment. The analysis also showed that ACT/SAT scores were not predictive of dual enrollment participation, although high school GPAs were highly predictive. Concern about

being able to pay for college was found to be significant, as well as attending a private high school and having a small class size.

Kanny's (2014) second research question asked whether dual enrollment have an effect on first year engagement and college grades. Kanny found that dual enrollment participation did not have a significant effect on first year college grades or for engagement activities of active and collaborative learning, participation in educationally enriching experiences, or perceptions of a supportive campus. However, dual enrollment did have a profound effect upon faculty-student interaction.

Kanny's (2014) third research question asked if there was a possible mediating effect of student engagement in dual enrollment's impact on college grades. After the finding that college grades were not significantly affected by dual enrollment, Kanny looked for an interaction between specific engagement categories with dual enrollment to find an effect on first year college grades. However, no significant interactions were found.

Kanny's (2014) fourth research question asked whether the effects of dual enrollment participation on first year engagement outcomes (active learning, interaction with faculty, personal enrichment through student activities, and feeling supported by the campus) vary by the demographic characteristics of students. In terms of gender, men benefited significantly more than women through dual enrollment effects upon every engagement category. In terms of first generation students versus non-first generation students, it was found that first generation students did experience a positive effect upon educationally enriching experiences and first year grades. In terms of prior academic achievement, Kanny found that dual enrollment had no effect upon later outcomes regardless of the level of prior academic achievement.

Kanny's (2014) fifth and final research question asked whether any engagement categories were mediators of dual enrollment effects upon first year college grades. The only student demographic which had a significant effect upon first year grades through dual enrollment were first generation students, who also had only had one significant engagement category influenced by dual enrollment, educationally enriching experiences. Kanny did not find a significant interaction between the two. In other words, dual enrollment did not affect college grades by influencing educationally enriching experiences.

The Kanny (2014) study is significant because of the investigation of engagement as a mediating effect of dual enrollment on later outcomes. Although no mediating effects were found, the dataset was not representative of college students nationally. Subsequent research may reveal more significance in connecting dual enrollment with student engagement.

Giani et al. (2014) analyzed the effects of dual enrollment on access to college, persistence into the second year, and graduation. Their dataset described students in the state of Texas that continued on to a college in Texas. The authors of this study noted the limitations that have accompanied many studies of dual credit and claimed to overcome these barriers by using propensity score matching as the statistical method to estimate the effects of dual credit on student outcomes.

Giani et al. (2014) admitted some limitations to their own study, acknowledging a lack of data concerning students who matriculate out of state, ignorance of unobservable characteristics like motivation, and that the data did not specify the location of the dual enrollment class – a factor that has been analyzed previously in other studies and shown to be significant (Speroni, 2011a). Giani et al. (2014) utilized a quasi-experimental method to compare students in districts that offered dual enrollment with students in districts that did not. The researchers postulated

that this population would make a better control group than the population in districts that had the opportunity to take dual enrollment and did not.

Giani et al. (2014) explained that dual enrollment participation excelled among Hispanics and whites, females, and gifted students. Also, high standardized scores in math correlated strongly with dual enrollment participation. Finally, dual enrollment exceeded AP enrollment for advanced math, English language arts, and computer science but lagged AP in other humanities-based courses. As a dichotomous variable, Giani et al. found enrollment intensity, persistence to the second year, and completion to be significantly affected by dual enrollment participation. This held true for two-year and four-year institutions. As a continuous variable, Giani et al. (2014) accounted that the benefits of dual enrollment increased with each successful course taken, contrary to the findings of An (2013a). Whether dual enrollment was analyzed as a treatment to orient the student to college or calculated as a cumulated effect that builds with each course taken and the credit earned, Giani et al. (2014) concluded dual enrollment benefited students.

An and Taylor (2015) examined the effect of dual enrollment on college readiness using Conley's (2007) Framework of College Readiness. Traditional measures of college readiness have only included cognitive measures such as standardized test scores and the lack of remediation. Furthermore, these measures have been assessed early in college rather than over time. However, other non-cognitive domains are pertinent to college readiness including a self-image that is positive, a view of the self that is realistic, the patience to navigate bureaucracy, an ability to delay gratification, access to social capital, experience in leadership, and a base of practical knowledge in a field of study. Conley's 2007 framework captures non-cognitive



characteristics of college readiness under four broad domains: key cognitive strategies, key content knowledge, key learning skills and techniques, and key transition knowledge and skills.

An and Taylor (2015) asked if dual enrollment students were better prepared than non-participating peers in cognitive and non-cognitive aspects of college readiness. Non-participating peers were subdivided into those students who earned exam-based credit, AP or IB courses, and the remaining students who did not earn any college credits in high school. The study leveraged the 2008 results of a key study, the Wabash National Study of Liberal Arts Education (WNSLAE) that was administered at 23 four-year institutions across the nation to assess the state of liberal arts education in the United States. The institutions who administered the survey were primarily private and located in either the Midwest or the Northeast. The same institutions also administered the National Survey of Student Engagement (NSSE) that same year. An and Taylor combined the survey results and categorized a subset of the responses into the four domains of college readiness by Conley (2007).

The analysis of An and Taylor (2015) estimated the effects of dual enrollment, exam-based credit, and non-accelerators using institutional level fixed effects models. Each institution represented a distinct sample with unique characteristics and requirements for admissions and the acceptance of credits. Using a fixed effects model enabled each sample to be analyzed based on the unique parameters of each institution. After measuring the fixed effects, the samples were combined and analyzed using traditional regression models controlling for ACT scores, native English speaking fluency, the number of siblings, disability, parental education, gender, and race. The final sample size was 4,023 students.

Each subgroup differed demographically (An & Taylor, 2015). Exam-based credit accelerators tended to be have higher ACT scores, fewer brothers and sisters, have parents with a

graduate degree, be male, and be White or Asian. The exam-based accelerators also tended to score the highest on the four domains of college readiness.

Dual enrollment accelerators were more like non-accelerators in racial diversity, gender (more females), sibling count, disability, and English fluency. Yet, dual enrollment accelerators had parents with more education and higher ACT scores. The benefits of exam-based acceleration and dual enrollment acceleration were not significantly different, leading An and Taylor (2015) to conclude that both means of acceleration were equally effective.

In conclusion, An and Taylor (2015) found that dual enrollment students were less college ready than exam-based accelerators but more college ready than non-accelerators, there was no statistical basis to claim that either form of acceleration was superior, and that the effect sizes of acceleration were modest at best. The researchers had admitted a limitation for generalizability of the study and speculated that the effect size of acceleration might be larger in a representative sample of all college students. It should be noted that An and Taylor did not attempt to control for self-selection as they attempted to delve further into the concept of college readiness.

## Chapter Summary

The literature reviewed above demonstrates an increasing availability, quantity, and quality of data for dual enrollment. Precision by leading scholars in the field regarding the assessment of dual enrollment has increased. The adoption of regression models (Karp et al., 2007; Swanson, 2008) and quasi-experimental methods like discontinuity regression (Speroni 2011a; 2011b) and propensity score matching (An, 2009, 2013a; 2013b; Giani et al., 2014; Jorgensen, 2013; Kanny, 2014; Struhl & Vargas, 2012) more accurately assess the effect of dual enrollment by controlling for observable characteristics like prior academic performance and socioeconomic status. Precision may continue to increase as the various factors that are omitted from data come to be included as standard data. The refinement of concepts like socioeconomic class and college readiness will also be necessary to fully understand the effects of dual enrollment.

## CHAPTER 3

### METHODOLOGY

This chapter introduces the research methodology and procedures employed in this study to determine the relationship between dual enrollment participation and subsequent academic outcomes at a community college. This chapter contains an explanation of the research design, the research questions and null hypotheses, population, data collection, instrumentation, data analysis, and chapter summary.

The purpose of this study was to explore the relationship of dual enrollment course participation by comparing first-time, full-time traditional community college students who participated in dual enrollment to peers that did not participate in dual enrollment. For the purpose of this study, dual enrollment participation was defined as taking one or more dual enrollment courses. Impact was assessed by measurable outcomes: remediation rates, number of credits earned in the first semester, comparisons of first semester and first year grade point averages, persistence to the second year, final college GPA, and completion rates in 2 years and 3 years. Propensity score matching was utilized to control for extraneous variables (An, 2013a; 2013b; Giani et al., 2014; McMillan & Schumacher, 2010; Struhl & Vargas, 2012).

The research design for this study employed a matched-sample procedure and quantitative analyses. This study used a quasi-experimental matched-sample procedure to balance covariates in the respective control and treatment groups (Henry, Gordon, & Rickman, 2006; McMillan & Schumacher, 2010). Details of the matching procedure were included in Chapter 4. Following the matching procedure, quantitative procedures were used to assess whether differences in community college outcomes were significant.

Propensity score matching has enabled researchers to match each treatment case with one or more control cases based on a score created from covariates which express the likelihood or propensity of the participant to choose treatment (Adelson, 2013). Propensity score matching emerged from the fields of econometrics (Heckman, 1978; Heckman, 1979) and statistics (Rosenbaum & Rubin, 1983) as a method for inferring causal effects in observational studies. Propensity score matching techniques have been refined over time (Becker & Ichino, 2002; Joffe & Rosenbaum, 1999; Mickey & Greenland, 1989; Rosenbaum & Rubin, 1984; Rosenbaum & Rubin, 1985; Rubin, 1997; Winship & Morgan, 1999) and appear in standard textbooks on statistical analysis (Guo & Fraser, 2009, 2014; McMillan & Schumacher, 2010). Many practical applications use propensity score matching from medical dosing studies (Imbens, 2000) to the impact of environmental regulations (List, Millimet, Fredriksson, & McHone, 2003) to political science (Ho et al., 2007). Academic articles intended to explicate and encourage propensity score matching are abundant (Adelson, 2013; Caliendo & Kopeinig, 2008; Garrido, Kelley, Paris, Rosa, Meier, Morrison, & Aldridge, 2014). Researchers have used propensity score matching in dissertations concerning dual enrollment previously (An, 2009; Jorgensen, 2013; Kanny, 2014).

Propensity score matching has been used previously to control for extraneous variables like prior academic indicators such as high school GPA or ACT scores, gender, and socioeconomic status (An, 2013a; 2013b; Giani et al., 2014; Struhl & Vargas, 2012). Although propensity score matching addresses potential confounding factors in extraneous variables (Ho, et al., 2007), it cannot balance for unobserved characteristics like a randomized experiment (Joffe & Rosenbaum, 1999). Extraneous variables should be controlled during analysis (McMillan and Schumacher, 2010). Lack of control in extraneous variables introduces bias into the analysis. A research design that takes these forms of variability into consideration achieves

credibility concerning the truthfulness of the results (McMillan & Schumacher, 2010). Once the propensity score matching procedure was completed the resulting treatment and control groups were compared using statistical methods.

The following criteria were used to refine the data used for the research questions. The research questions concerning first, second, or third semesters exclude summer terms. Summer terms are also not counted in the speed of completion questions (2 years - 4 semesters not counting summers; 3 years - 6 semesters not counting summers). Summer semesters would be included in the cumulative GPA at graduation. GPA excludes college courses helping students to prepare for college work whether. For those students earning two degrees simultaneously, only the courses applying to degree 1 as designated in the student information system would be included in the cumulative GPA and no subsequent coursework would be included.

### Research Questions and Corresponding Null Hypotheses

This study was used to analyze the relationship between dual enrollment participation and subsequent community college outcomes based on data about students entering college between fall 2008 and fall 2012. The focus of the study was on the following 8 research questions and the corresponding null hypotheses.

RQ1: Is there a significant difference in the rates of remediation during the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>1. There is no significant difference in the rates of remediation during the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ2: Is there a significant difference in the number of credit hours earned in the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>02</sub>. There is no significant difference in the number of credit hours earned in the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ3: Is there a significant difference in the first semester grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>03</sub>. There is no significant difference in the first semester grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ4: Is there a significant difference in the first year grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>04</sub>. There is no significant difference in the first year grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ5: Is there a significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>5. There is no significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ6: Is there a significant difference in the cumulative grade point averages at completion of college between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>6. There is no significant difference in the cumulative grade point averages at completion of college between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ7: Is there a significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>7. There is no significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment.

RQ8: Is there a significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>8. There is no significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment.

### Population



The population for this study included first-time, full-time students who graduated from public high schools in the service area of Northeast State Community College in May or June of a five year span from 2008 through 2012, then entered Northeast State Community College between June to September of the year of graduation seeking a two-year degree. Any students completely withdrawing during their first semester were excluded to prevent an exaggerated effect on the analysis. In addition, all students in the population were also required to have completed a FAFSA and the ACT. The population is described before and after the matching procedure at the beginning of Chapter 4.

#### Instrumentation

The study used archived data from the student information system at Northeast State Community College. The student information system is the central repository of student demographic and academic information for an academic institution. An assessment of centralized data from higher education institutions housed at the offices of the Tennessee Higher Education Commission (THEC) found that the state level data had a high level of validity with no major concerns (Malo, 2011). The aforementioned THEC data were aggregated from the student information systems at Tennessee higher education institutions, demonstrating an active regard for the accuracy of system reporting. See Table 1 below for a description of the variables drawn from the student information system.

Table 1

*Variable Types, Variable Labels, Levels of the Variable, and Scale of Measurement*

Variable Type	Variable Label	Levels of the Variable	Scale of Measurement
Independent Variable	Number of Dual Enrollment Credit Hours in Participation	0 to 54	Ratio
Dependent Variables	Number of credit hours taken each semester disaggregated by course level	0 to 24	Ratio
	Number of credit hours passed in each semester disaggregated by course level	0 to 24	Ratio
	Each semester GPA disaggregated by course level	0 to 4.0	Ratio
	Cumulative GPA at end of first year disaggregated by course level	0 to 4.0	Ratio
	Persistence to second year	0 = No 1 = Yes	Nominal
	Cumulative GPA at completion of degree 1	0 to 4	Ratio
	Completion within 2 years	0 = No 1 = Yes	Nominal
	Completion within 3 years	0 = No 1 = Yes	Nominal
	Number of Fall/Spring Semesters to earn Degree 1	1 to 16	Interval
	Number of Summer Semesters Attended	1 to 6	Interval

Table 1 (continued)

*Variable Types, Variable Labels, Levels of the Variable, and Scale of Measurement*

Variable Type	Variable Label	Levels of the Variable	Scale of Measurement
Demographic Covariates	Gender	0 = Female / 1 = Male	Nominal
	Ethnicity	0 = White 1 = Black or African America 2 = Asian 3 = American Indian 4 = Alaskan Native 5 = Native Hawaiian or Other Pacific Islander	Nominal
	Highest School Completed by Parent 1	1 = Middle school/junior high 2 = High school 3 = College or beyond 4 = Other/unknown	Nominal
	Highest School Completed by Parent 2	1 = Middle school/junior high 2 = High school 3 = College or beyond 4 = Other/unknown	Nominal
	Pell-eligibility Award Level	0 = None 1 = Some 2 = Full	Nominal
	Dependent/Independent Status at entry	0 = Dependent 1 = Independent	Nominal
	Year of High School graduation	2008, 2009, 2010, 2011, 2012	Nominal
Academic Covariates	High School GPA	0 to 4.0	Ratio
	ACT Composite Score	1 to 36	Ordinal
	ACT English Score	1 to 36	Ordinal
	ACT Mathematics	1 to 36	Ordinal
	ACT Reading	1 to 36	Ordinal
	ACT Science	1 to 36	Ordinal
	Number of exam-based college credits at entry (AP, CLEP, etc.)	0 to 24	Ratio

### Data Collection

Prior to collecting and analyzing data, this study was submitted to the Institutional Review Board (IRB) at East Tennessee State University. That IRB determined that this study did not constitute human subject research and gave an exempt status to it (see Appendix A). Afterwards, permission to conduct this study was requested and obtained from the IRB at Northeast State Community College (see Appendix B). The data included the number of dual enrollment credits earned, select demographic variables, and academic variables (See Table 1 above). To protect the identity of the students in the population, no identifying information was requested such as name, address, date of birth, SSN, institutional Student ID number, parents' names, parents' gender, student marital status, or parent marital status. Additionally, because there is no intention to compare high schools or communities, no data concerning the city or county of residence, home or school zip code, or high school attended was requested. Finally, no information concerning scholarships received and the maintenance of such scholarships was requested. The Director of Research and External Reporting at Northeast State Community College retrieved the data and exported from the student information system into a text file, removed all identifying information from the data, and delivered the data to the researcher in person via a USB drive.

### Data Analysis

The propensity score matching procedure and the subsequent data analyses were conducted using version 3.2.1 of R: A language and environment for statistical computing (R Core Team, 2015) facilitated by the graphic user interface RStudio version 0.99.467 (RStudio Team, 2015). Reports of means and standard deviations were given before and after the

matched-sample procedure above. Because full matching was selected as the method of matching, no subjects were removed to achieve balance of covariates. After matching, the significance of statistical differences were measured through inferential statistics. The .05 significance level was selected for data analysis.

Research questions 1, 5, 7, and 8 were analyzed using a series of chi-square procedures. Research questions 2, 3, 4, and 6 were analyzed using a series of independent samples *t*-tests. The independent variable was dual enrollment participation. The dependent variables were rates of remediation, number of credits earned in the first semester, first semester GPA, cumulative GPA for first and second semesters, rates of persistence to the third semester, cumulative GPA at graduation, and rates of completion in 2 years and 3 years.

### Chapter Summery

Chapter 3 consisted of the research methodology and procedures employed in this study including an explanation of the research design, the research questions and null hypotheses, population, data collection, instrumentation, data analysis, and chapter summary. The outcome of the study was obtained from data retrieved from a student information system at Northeast State Community College. Propensity score matching was briefly explained and the statistical procedures for assessing the null hypotheses were identified.

## CHAPTER 4

### FINDINGS

The purpose of this study was to explore the relationship of dual enrollment course participation by comparing first-time, full-time traditional community college students who participated in dual enrollment to peers that did not participate in dual enrollment. For the purpose of this study, dual enrollment participation was defined as taking one or more dual enrollment courses. Impact was assessed by measurable outcomes: remediation rates, number of credits earned in the first semester, comparisons of first semester and first year grade point averages, persistence to the second year, final college GPA, and completion rates in 2 years and 3 years of degree time.

The population for this study included 1,232 first-time, full-time students who graduated from public high schools in the service area of Northeast State Community College in May or June of a five year span from 2008 through 2012, then entered Northeast State Community College between June to September of the year of graduation seeking a two-year degree. Any students completely withdrawing during their first semester were excluded to prevent an exaggerated effect on the analysis. In addition, all students in the population were also required to have completed a FAFSA and the ACT. The population demographics is given in Table 2 below.

#### Matching Procedure and Demographics

The data were received from the Director of Research and External Reporting at Northeast State Community College as described in Chapter 3. Table 2 describes the

demographics of the population. I imported the data into Microsoft Access and manipulated the data into following format shown in Table 3 (following Table 2).

Table 2  
*Demographics of Population*

	Dual Enrollment		Nondual Enrollment		Total	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
<b>Gender</b>						
Female	142	57.7	451	45.7	593	48.1
Male	<u>104</u>	<u>42.3</u>	<u>535</u>	<u>54.3</u>	<u>639</u>	<u>51.9</u>
Total	246	100.0	986	100.0	1232	100.0
<b>Ethnicity</b>						
Not White	7	2.8	40	4.1	47	3.8
White	<u>239</u>	<u>97.2</u>	<u>946</u>	<u>95.9</u>	<u>1185</u>	<u>96.2</u>
Total	246	100.0	986	100.0	1232	100.0
<b>Dependent Status</b>						
False	13	5.3	41	4.2	54	4.4
True	<u>233</u>	<u>94.7</u>	<u>945</u>	<u>95.8</u>	<u>1178</u>	<u>95.6</u>
Total	246	100.0	986	100.0	1232	100.0
<b>Pell Award Level</b>						
No Award	159	64.6	501	50.8	660	53.6
Partial Award	44	17.9	257	26.1	299	24.3
Full Award	<u>43</u>	<u>17.5</u>	<u>228</u>	<u>23.1</u>	<u>271</u>	<u>22.1</u>
Total	246	100.0	986	100.0	1232	100.0
<b>At Least One Parent with College or More</b>						
False	105	42.7	480	48.7	585	47.5
True	<u>141</u>	<u>57.3</u>	<u>506</u>	<u>51.3</u>	<u>647</u>	<u>52.5</u>
Total	246	100.0	986	100.0	1232	100.0

Table 3  
*Structure of Manipulated Data for Analysis*

Variable Type	Variable Label	Levels of the Variable	Scale of Measurement
Independent Variable	DE_PARTICIPATION	TRUE, FALSE	Logical
Demographic Variables	IS_FEMALE	TRUE, FALSE	Logical
	IS_WHITE*	TRUE, FALSE	Logical
	AT_LEAST_ONE_PARENT_WITH_COLLEGE_OR_MORE	TRUE, FALSE	Logical
	PELL_AWARD_LEVEL	NO AWARD PARTIAL AWARD FULL AWARD	Nominal
	DEPENDENT_STATUS	TRUE, FALSE	Logical
Academic Variables	HSGRAD_GPA	0 to 4	Ratio
	ACT_COMPOSITE	1 to 36	Ordinal
	ACT_ENGLISH	1 to 36	Ordinal
	ACT_MATH	1 to 36	Ordinal
	ACT_READING	1 to 36	Ordinal
	ACT_SCIENCE	1 to 36	Ordinal
Dependent Variables	RQ1_FIRST_SEM_LS	TRUE, FALSE	Logical
	RQ2_FIRST_SEM_HOURS_EARNED	0 to 19	Interval
	RQ3_FIRST_SEM_GPA	0 to 4	Interval
	PersistToSecondSemester**	TRUE, FALSE	Logical
	RQ4_FIRST_YR_GPA	0 TO 4	Interval
	RQ5_PERSIST_TO_SECOND_YR	TRUE, FALSE	Logical
	RQ6_CUMULATIVE_GPA	0 to 4	Interval
	RQ7_GRAD_IN_100_PERCENT	TRUE, FALSE	Logical
	RQ8_GRAD_IN_150_PERCENT	TRUE, FALSE	Logical

\*Minority students were so few that the racial and ethnic categories were combined to prevent an accidental FERPA violation.

\*\*This was not a research question, but had to be identified for calculations.



I imported the data into the R environment and matched the data using the MatchIt package version 2.4-21 (Ho, Imai, King, & Stuart, 2013). The MatchIt package contains several methods of matching and references other packages to supply a maximal set of analytical options to researchers. I analyzed the data using several options and assessed for balance of covariates (See Appendix C). Some methods matched every case while others allowed the ratio of control cases to treatment cases to be selected. The quality of balance was assessed by taking the absolute value of each difference in means between the treatment and control groups and adding them to create a sum for each method. Full matching was selected as the method which best balanced the covariates while keeping all treatment and control cases. Each case was assigned a propensity score in the data reports and a weight so that the covariates were balanced as evenly as possible. The statistical procedures for the research questions used the weights to control for the covariates.

The population consisted of 639 males and 593 females. The vast majority of students were White. The number of minorities was so small that the possibility of an accidental FERPA violation was of concern. To retain the 47 minority students in the study and avoid any risk of identifying a person by context, I combined the racial and ethnic identities under the rubric of Not White, which was coded FALSE in the IS\_WHITE field in the data. Fifty-four students were independent of a parent or guardian, while 1,178 were still dependent. The 647 students with at least one parent who had a college degree were joined by 585 students that did not have a parent with a college degree. Dual enrollment participants numbered 246, leaving 986 non-participants in the population.

## Pre-Matching and Post-Matching Comparison

After the matching procedure, summaries of balance for the unmatched and full matched data were available. The treatment group which participated in dual enrollment were more likely to be female and had a great advantage in terms of high school GPA, ACT scores (especially reading and English). Table 4 below gives a full report of the balance of unmatched data.

Table 4  
*Summary of Covariate Balance for Unmatched Data*

Variable Name	Means Treated	Means Control	Mean Diff	Absolute Mean Diff
PROPENSITY_SCORE	0.2624	0.184	0.0783	0.0783
IS_FEMALEFALSE	0.4228	0.5426	-0.1198	0.1198
IS_FEMALETRUE	0.5772	0.4574	0.1198	0.1198
IS_WHITETRUE	0.9715	0.9594	0.0121	0.0121
HSGRAD_GPA	3.4338	3.1602	0.2736	0.2736
ACT_ENGLISH	22.4512	20.9412	1.51	1.51
ACT_MATH	21.5691	20.6329	0.9362	0.9362
ACT_READING	23.3415	21.6866	1.6549	1.6549
ACT_SCIENCE	22.1911	21.0243	1.1667	1.1667
ACT_COMPOSITE	22.1829	20.927	1.2559	1.2559
DEPENDENT_STATUSTRUE	0.9472	0.9584	-0.0113	0.0113
PELL_AWARD_LEVELNo Award	0.6463	0.5081	0.1382	0.1382
PELL_AWARD_LEVELPartial Award	0.1789	0.2606	-0.0818	0.0818
AT_LEAST_ONE_PARENT_WITH_COLL EGE_OR_MORETRUE	0.5732	0.5132	0.06	0.06
Sum of Mean Difference Absolute Values				7.4186

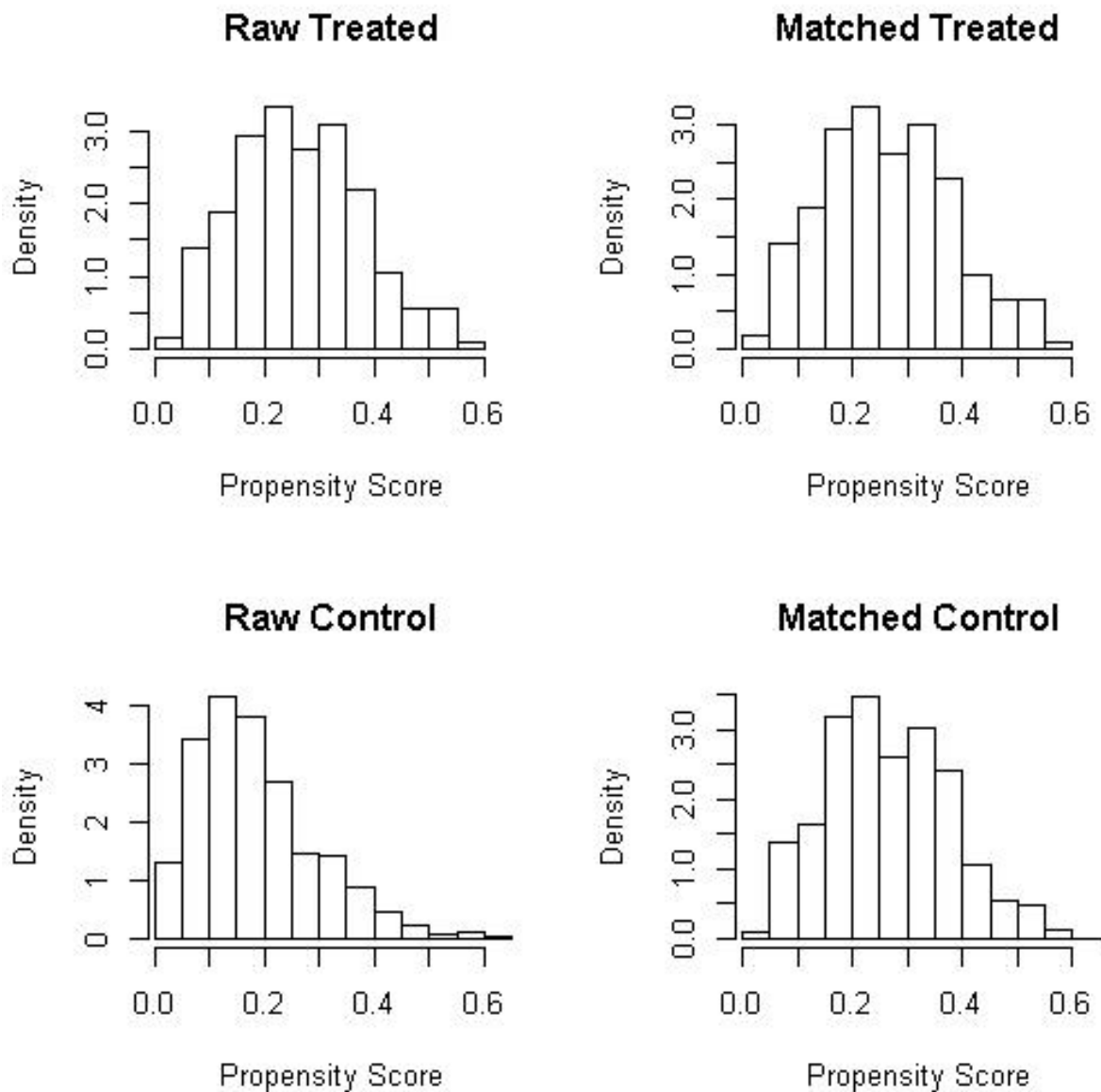
The matched data were much closer in means between the treatment and control group. The improvement of the sum of means was over 900% ( $7.4186/0.7948$ ). Although the treatment group and control group contained all cases used in the unmatched data, the use of a propensity

score and weighting eliminated most of the evident bias in the data revealed through the difference in means sum. With the completion of the matching procedure, the analysis of data in regard to the research questions proceeded. See Table 5 below for the summary of covariate balance for the full matched data.

Table 5  
*Summary of Covariate Balance for Full Matched Data*

Variable Name	Means Treated	Means Control	Mean Diff	Absolute Mean Diff
PROPENSITY_SCORE	0.2624	0.2625	-0.0002	0.0002
IS_FEMALEFALSE	0.4228	0.4243	-0.0016	0.0016
IS_FEMALETRUE	0.5772	0.5757	0.0016	0.0016
IS_WHITETRUE	0.9715	0.9748	-0.0032	0.0032
HSGRAD_GPA	3.4338	3.4454	-0.0117	0.0117
ACT_ENGLISH	22.4512	22.3404	0.1109	0.1109
ACT_MATH	21.5691	21.3976	0.1715	0.1715
ACT_READING	23.3415	23.0571	0.2843	0.2843
ACT_SCIENCE	22.1911	22.1661	0.025	0.025
ACT_COMPOSITE	22.1829	22.054	0.1289	0.1289
DEPENDENT_STATUSTRUE	0.9472	0.9573	-0.0101	0.0101
PELL_AWARD_LEVELNo Award	0.6463	0.6708	-0.0245	0.0245
PELL_AWARD_LEVELPartial Award	0.1789	0.1635	0.0154	0.0154
AT_LEAST_ONE_PARENT_WITH _COLLEGE_OR_MORETRUE	0.5732	0.5673	0.0059	0.0059
Sum of Mean Diff Absolute Values				0.7948

Figure 1 contains histograms to graphically represent the treated and control group before and after the assignment of propensity scores and weights. The propensity scores describe the likelihood of a participant self-selecting the treatment. The assigned weights are used to balance the covariates so that selection bias is eliminated in the analysis.



*Figure 1.* Propensity Score Distributions Before and After Matching Procedure

Figure 1 shows that the propensity scores for treatment and control cases. Prior to weighting, the raw control group peaked at 0.1 and declined rapidly. The treated cases peaked at 0.2 and again at 0.4. After weighting the control cases, the matched control histogram is nearly identical to the matched treated histogram.

## Results

### Research Question 1

RQ1: Is there a significant difference in the rates of remediation during the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>1. There is no significant difference in the rates of remediation during the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference between first-time, full-time freshmen in the rates of remediation during the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment. The two variables were dual enrollment participation with two levels (true or false) and remediation participation (true or false). Dual enrollment participation and remediation participation were found to be significantly related,  $\chi^2(1, N = 1,232) = 16.89, p < .001$ ). Therefore, the null hypothesis was rejected. Dual enrollment participants were significantly less likely to need remediation at the beginning of college. The squared Cramer's phi coefficient revealed a small effect ( $\phi^2 = 0.01$ ). A weighted odds ratio showed that students participated in dual enrollment were nearly four times less likely (0.26) to require remediation in the first semester of college. Table 6 specifies the associated frequencies and percentages related to dual enrollment participation and participation in remedial coursework. Figure 2 shows the distribution of remediation between dual enrollment participants and non-dual enrollment participants.

Table 6  
*Weighted Dual Enrollment Participation and Remediation Rates*

Group	Remediation		No Remediation		Total
	<i>N</i>	%	<i>N</i>	%	
Non-Participants	126.38	93.4	859.62	78.4	986
Participants	9	6.6	237	21.6	246
<i>Total</i>	135.38	100.0	1096.62	100.0	1232

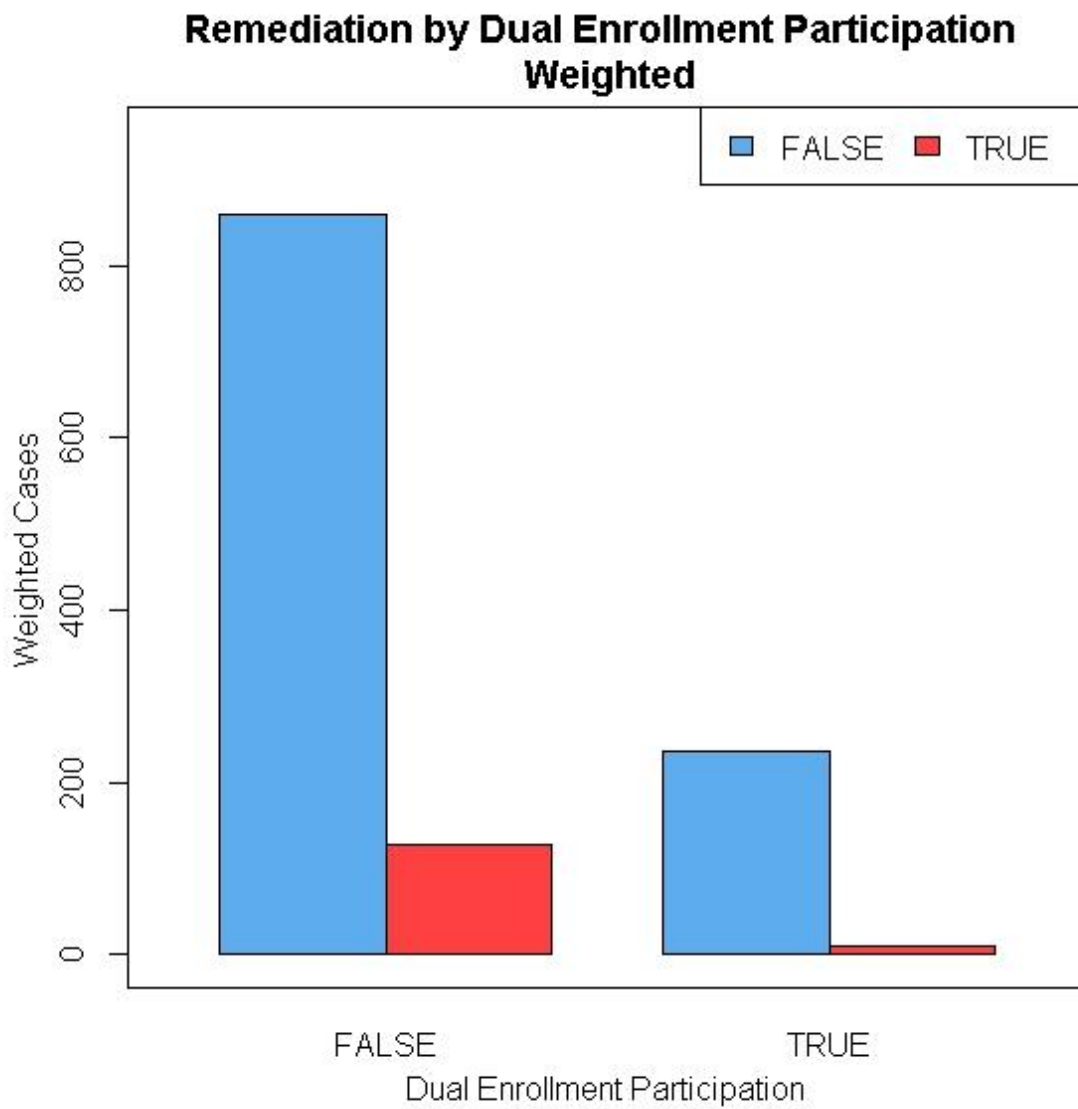


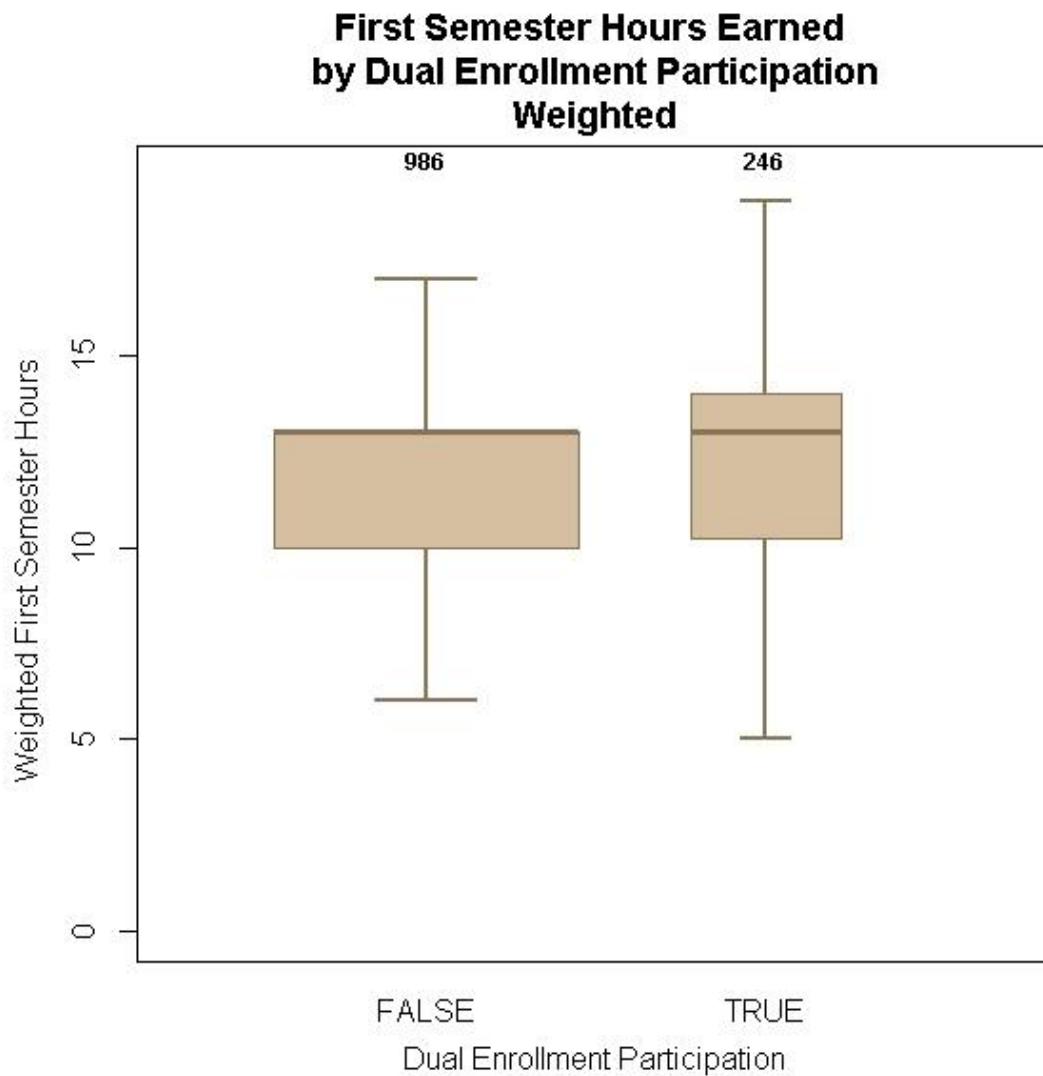
Figure 2. Remediation Participation by Dual Enrollment Participation

## Research Question 2

RQ2: Is there a significant difference in the number of credit hours earned in the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>2. There is no significant difference in the number of credit hours earned in the first semester of college between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted independent samples Welch's unequal variances *t*-test was conducted to determine if there was a significant difference in the mean number of credits earned in the first semester of first-time, full-time college students based on dual enrollment participation. The weighted *t*-test was significant,  $t(458.13, 1,232) = 3.27, p=.001$ . The 95% confidence interval for the difference in mean was 3.08 and 3.46. Therefore, the null hypothesis was rejected. The effect size as measured by Cohen's *d* was small to medium ( $d = 0.31$ ). Dual enrollment participants ( $M = 11.80, SD = 3.71$ ) on average earned .91 more credit hours in the first semester of college over non-dual enrollment participants ( $M = 10.89, SD = 4.67$ ). Figure 3 below shows the distributions for the first semester credits earned by dual enrollment participation.



*Figure 3.* First Semester Credits Earned by Dual Enrollment Participation

Research Question 3

RQ3: Is there a significant difference in the first semester grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment?



H<sub>03</sub>. There is no significant difference in the first semester grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted independent samples Welch's unequal variances *t*-test was conducted to determine if there was a significant difference in the mean first semester GPA of first-time, full-time college students based on dual enrollment participation. The weighted *t*-test was significant,  $t(465.76, 1,232) = 3.24, p=.001$ . The 95% confidence interval for the difference in mean was 3.05 and 3.43. Therefore, the null hypothesis was rejected. The effect size as measured by Cohen's *d* was small to medium ( $d = 0.30$ ). Dual enrollment participants ( $M = 3.12, SD = 0.97$ ) on average had a GPA that was .24 points higher than non-dual enrollment participants ( $M = 2.88, SD = 1.24$ ). Figure 4 shows the distributions for first semester GPA earned by dual enrollment participation.

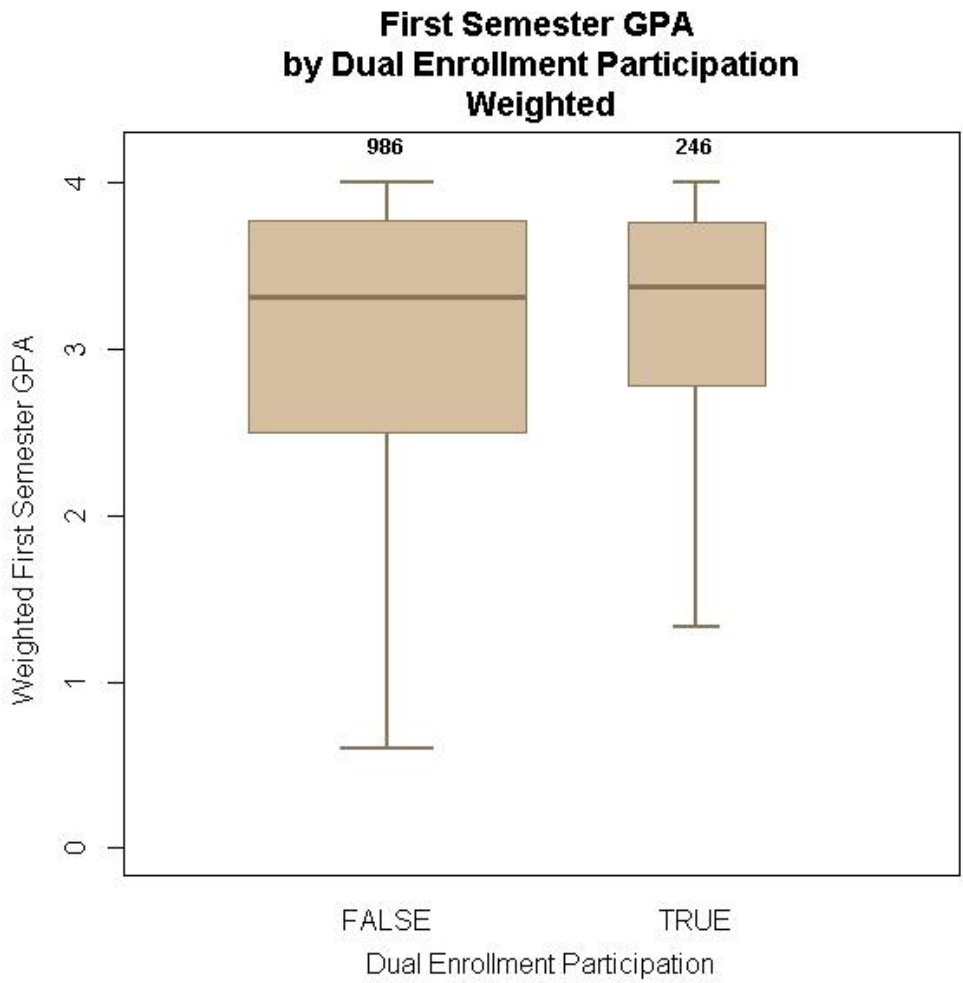


Figure 4. First Semester GPA by Dual Enrollment Participation

Research Question 4

RQ4: Is there a significant difference in the first year grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>4. There is no significant difference in the first year grade point averages between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted independent samples Welch's unequal variances  $t$ -test was conducted to determine if there was a significant difference in the mean first year GPA of first-time, full-time college students based on dual enrollment participation. The weighted  $t$ -test was not significant,  $t(402.16, 1,232) = 0.19, p=.85$ . The 95% confidence interval for the difference in mean was 0.05 and 0.33. Therefore, the null hypothesis was retained. Dual enrollment participants ( $M = 3.09, SD = 0.96$ ) had no significant difference in first year GPA than non-dual enrollment participants ( $M = 3.08, SD = 1.22$ ). Figure 5 shows the distributions for first year GPA earned by dual enrollment participation.

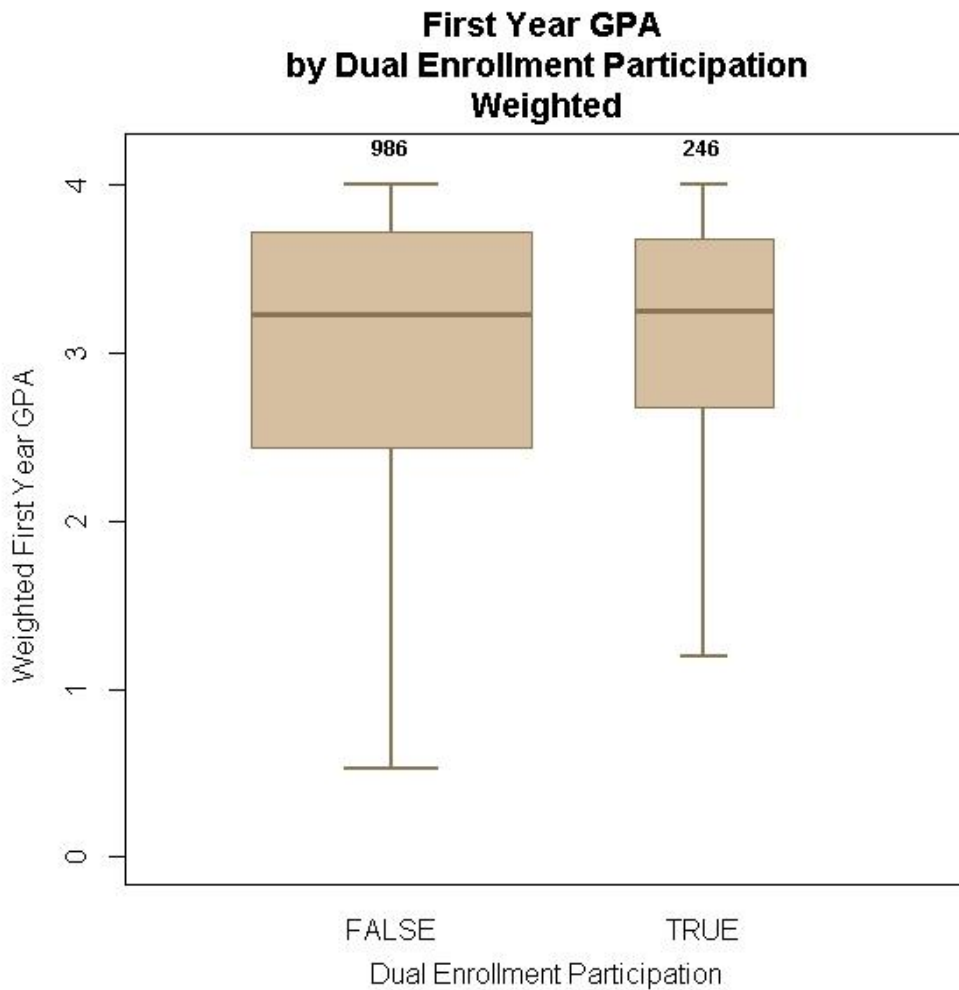


Figure 5. First Year GPA by Dual Enrollment Participation

### Research Question 5

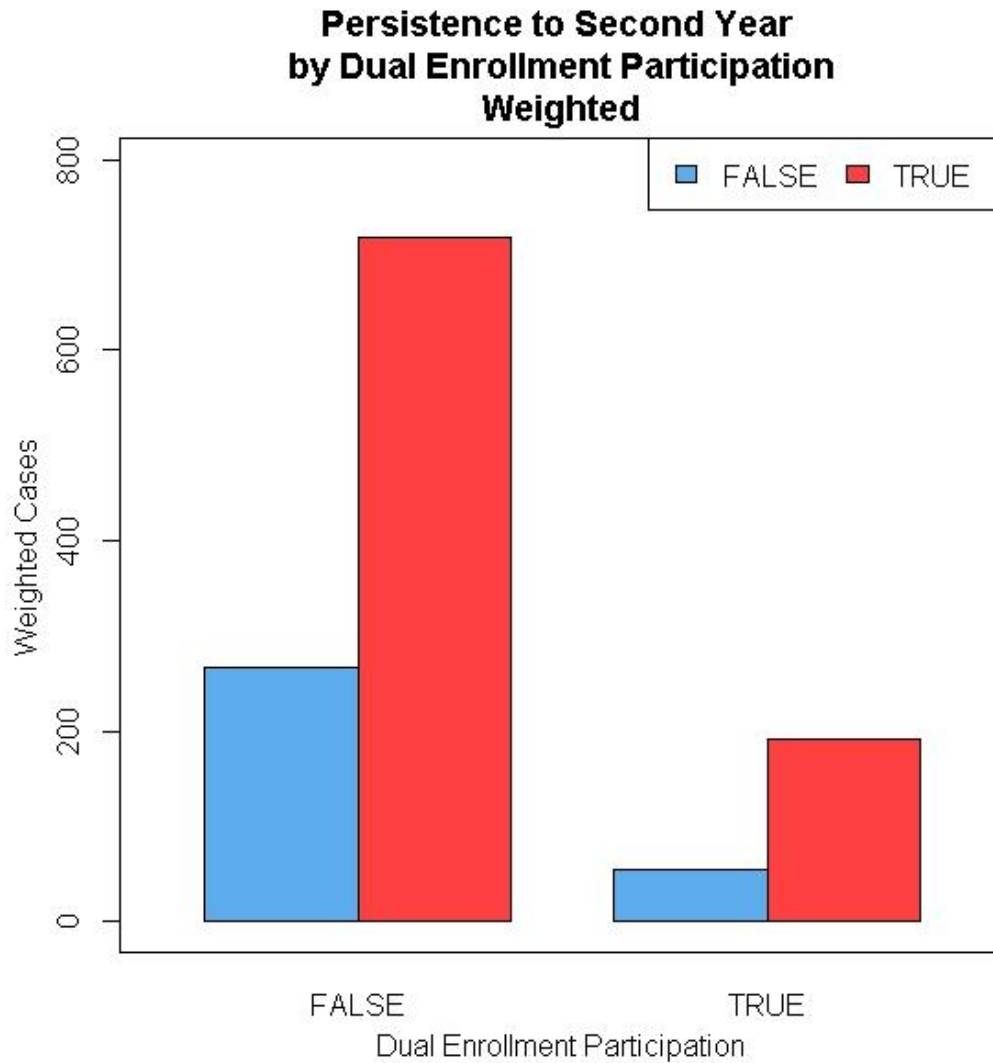
RQ5: Is there a significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>05</sub>. There is no significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment. The two variables were dual enrollment participation with two levels (true or false) and persistence to the second year (true or false). Dual enrollment participation and persistence to the second year of college were not found to be significantly related,  $\chi^2(1, N = 1,232) = 2.73, p = 0.09$ . Therefore, the null hypothesis was retained; there was no significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment.

Table 7  
*Weighted Dual Enrollment Participation and Rates of Persistence to the Second Year*

Group	Persisted		Did Not Persist		Total
	<i>N</i>	%	<i>N</i>	%	
Non-Participants	718.51	78.9	267.49	83.2	986
Participants	192	21.1	54	16.8	246
<i>Total</i>	910.51	100.0	321.49	100.0	1232



*Figure 6. Persistence to Second Year by Dual Enrollment Participation*

Research Question 6

RQ6: Is there a significant difference in the cumulative grade point averages at completion of college between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>6. There is no significant difference in the cumulative grade point averages at completion of college between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted independent samples Welch's unequal variances  $t$ -test was conducted to determine if there was a significant difference in the cumulative GPA of first-time, full-time college students based on dual enrollment participation. The weighted  $t$ -test was not significant,  $t(179.67, 1,232) = -0.07, p = .14$ . The 95% confidence interval for the difference in mean was 1.33 and 1.63; dual enrollment participants earned marginally lower cumulative GPAs than non-dual enrollment participants. Therefore, the null hypothesis was retained. Dual enrollment participants ( $M = 3.50, SD = 0.78$ ) had no significant difference in cumulative GPA than non-dual enrollment participants ( $M = 3.57, SD = 1.12$ ). Figure 7 shows the distributions for cumulative GPA earned by dual enrollment participation.

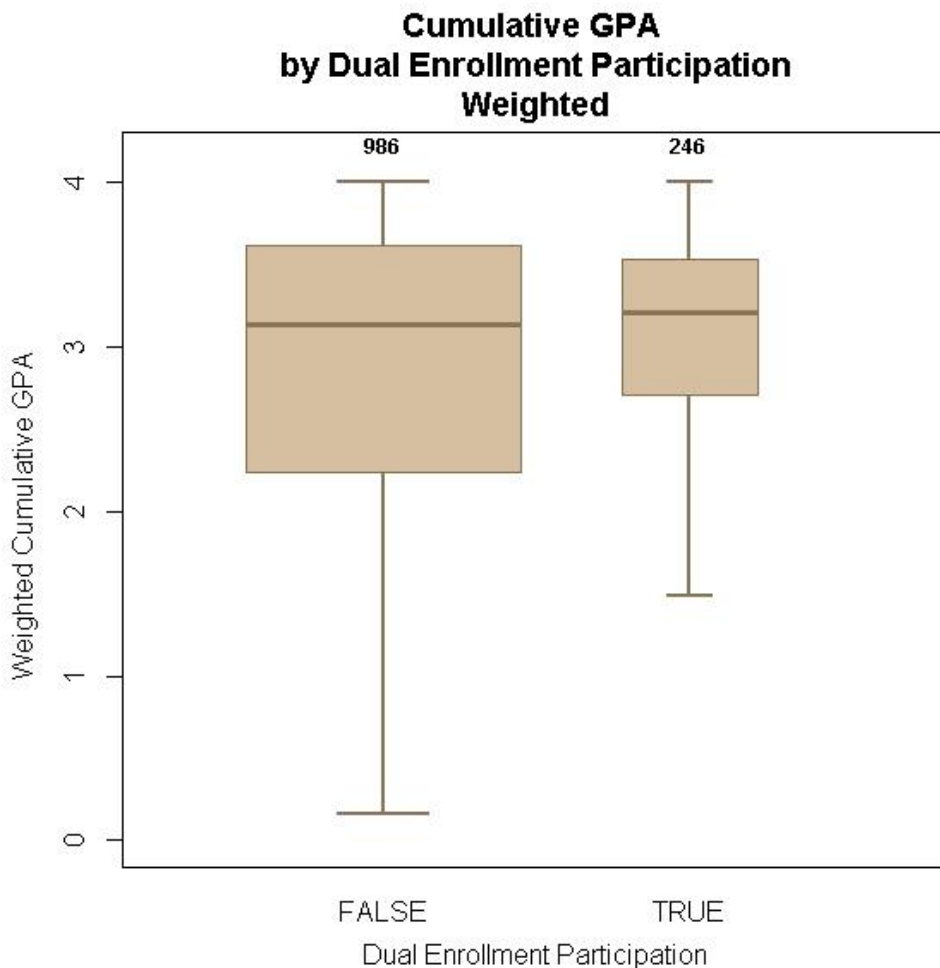


Figure 7. Cumulative GPA by Dual Enrollment Participation

### Research Question 7

RQ7: Is there a significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>7. There is no significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment. The two variables were dual enrollment participation with two levels (true or false) and completion in 2 years (true or false). Dual enrollment participation and completion in 2 years were found to be significantly related,  $\chi^2(1, N = 1,232) = 32.71, p < .001$ ). Therefore, the null hypothesis was rejected. Dual enrollment participants were significantly more likely to finish college in 2 years. The squared Cramer's phi coefficient revealed a small effect ( $\phi^2 = 0.03$ ). Following the advice of Witte and Witte (2010), I followed the effect size assessment with an odds ratio procedure to ascertain whether there was some importance to the treatment. A weighted odds ratio showed that students who participated in dual enrollment were 2.5 times more likely to finish in 2 years than students who did not participate in dual enrollment. Table 8 specifies the associated frequencies and percentages related to dual enrollment participation and completion in 2 years.

Table 8  
*Weighted Dual Enrollment Participation and Completion in 2 Years*

Group	Completion		No Completion		Total
	<i>N</i>	%	<i>N</i>	%	
Non-Participants	149.27	66.3	836.73	83.1	986
Participants	76	33.7	170	16.9	246
<i>Total</i>	225.27	100.0	1006.73	100.0	1232

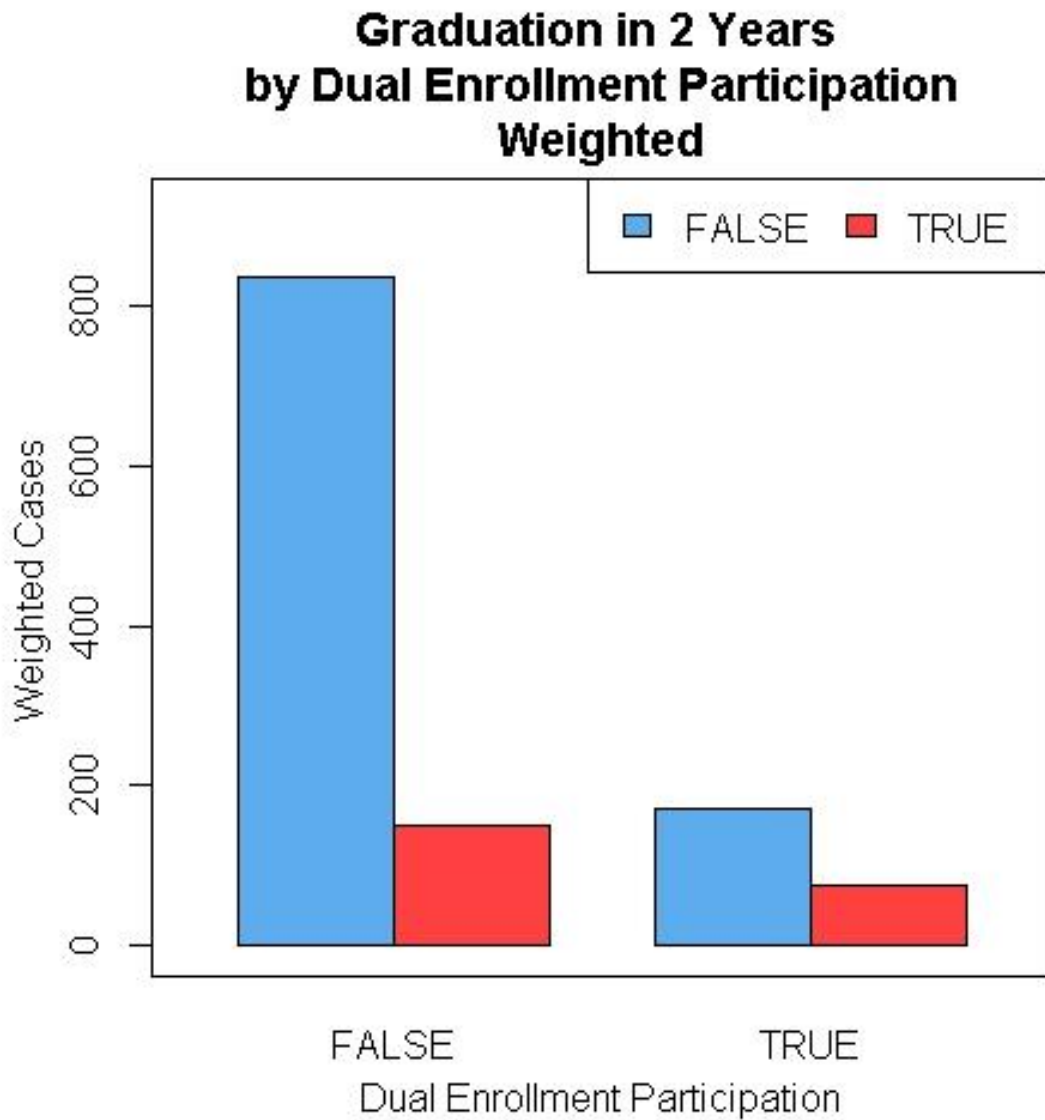


Figure 8. Graduation in 2 Years by Dual Enrollment Participation



## Research Question 8

RQ8: Is there a significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment?

H<sub>0</sub>8. There is no significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment.

A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment. The two variables were dual enrollment participation with two levels (true or false) and completion in 3 years (true or false). Dual enrollment participation and completion in 3 years were found to be significantly related,  $\chi^2(1, N = 1,232) = 13.11, p < .001$ ). Therefore, the null hypothesis was rejected. Dual enrollment participants were significantly more likely to finish community college in 3 years. The squared Cramer's phi coefficient revealed a small effect ( $\phi^2 = 0.01$ ). Following the advice of Witte and Witte (2010), I followed the effect size assessment with an odds ratio procedure to ascertain whether there was some importance to the treatment. A weighted odds ratio showed that students who participated in dual enrollment were 1.68 times more likely to finish in 3 years than students who did not participate in dual enrollment. Table 9 specifies the associated frequencies and percentages related to dual enrollment participation and completion in 3 years.

Table 9  
*Weighted Dual Enrollment Participation and Completion in 3 Years*

Group	Completion		No Completion		Total
	<i>N</i>	%	<i>N</i>	%	
Non-Participants	338.21	74.6	647.79	83.2	986
Participants	115	25.4	131	16.8	246
<i>Total</i>	453.21	100.0	778.79	100.0	1232

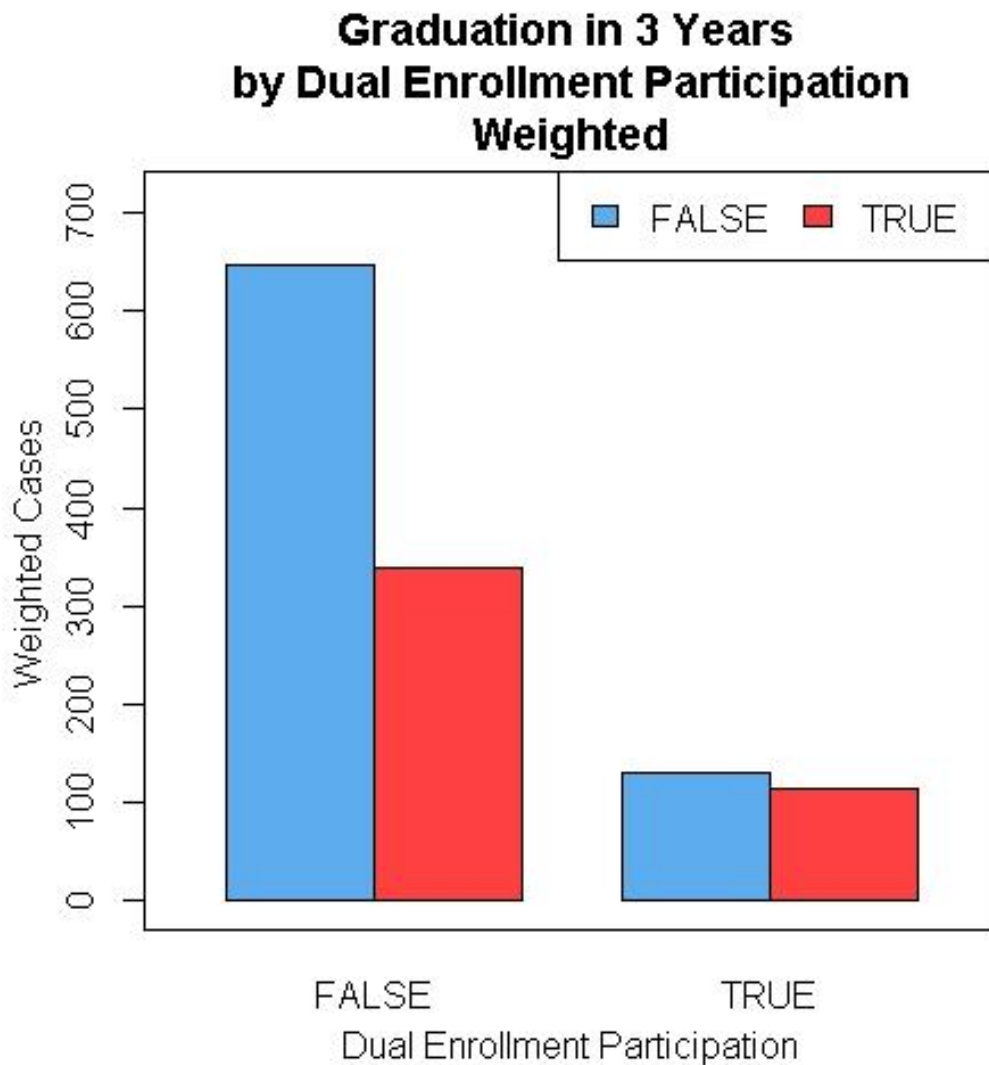


Figure 9. Graduation in 3 Years by Dual Enrollment Participation

## Chapter Summary

This chapter presented the analyses of data obtained from the student information system of Northeast State Community College regarding the academic outcomes of first-time, full-time freshmen entering between 2008 and 2012. Eight research questions and their respective corresponding null hypotheses were addressed. The study found that dual enrollment participants (a) were nearly four times less likely to take remediation than non-participants, (b) earned about 1 extra credit hour in the first semester of college, (c) earned a higher first semester GPA, (d) did not earn a higher first year GPA, (e) did not persist to the second year at higher rates than non-participants, (f) did not have a higher GPA at graduation, (g) were 2.5 times more likely to graduate at 100% of degree time, and (h) were 1.68 times more likely to graduate at 150% of degree time.

## CHAPTER 5

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to explore the relationship of dual enrollment course participation by comparing first-time, full-time traditional community college students who participated in dual enrollment to peers that did not participate in dual enrollment. For the purpose of this study, dual enrollment participation was defined as taking one or more dual enrollment courses. Impact was assessed by measurable outcomes: remediation rates, number of credits earned in the first semester, comparisons of first semester and first year grade point averages, persistence to the second year, final college GPA, and completion rates in 2 years and 3 years. Summary and discussion of findings, conclusions, and recommendations are overviewed in the following sections.

This study used archived data from the student information system at Northeast State Community College. The data included the number of dual enrollment credits earned, select demographic variables, and academic variables (See Table 1 in Chapter 3). To protect the identity of the students in the population, no identifying information was requested such as name, address, date of birth, SSN, institutional Student ID number, parents' names, parents' gender, student marital status, or parent marital status. Additionally, because there is no intention to compare high schools or communities, no data concerning the city or county of residence, home or school zip code, or high school attended was requested. Finally, no information concerning scholarships received and the maintenance of such scholarships was requested. The Director of Research and External Reporting at Northeast State Community College retrieved the data,

removed all identifying information, and exported from the student information system into a text file.

The population for this study included 1,232 first-time, full-time students who graduated from public high schools in the service area of Northeast State Community College in May or June of a five year span from 2008 through 2012, then entered Northeast State Community College between June to September of the year of graduation seeking a two-year degree. Any students completely withdrawing during their first semester were excluded to prevent an exaggerated effect on the analysis. In addition, all students in the population were also required to have completed a FAFSA and the ACT.

The population included 639 males and 593 females. The vast majority of students were White. The number of minorities was so small that the possibility of an accidental FERPA violation was of concern. To retain the 47 minority students in the study and avoid any risk of identifying a person by context, I combined the racial and ethnic identities under the rubric of Not White. Fifty-four students were independent of a parent or guardian, while 1,178 were still dependent. The 647 students with at least one parent who had a college degree were joined by 585 students that did not have a parent with a college degree. Dual enrollment participants numbered 246, leaving 986 non-participants in the population.

The propensity score matching procedure and the subsequent data analyses were conducted using version 3.2.1 of R: A language and environment for statistical computing (R Core Team, 2015) facilitated by the graphic user interface RStudio version 0.99.467 (RStudio Team, 2015). Reports of means and standard deviations were given before and after the matched-sample procedure. Because full matching was selected as the method of matching, no subjects were removed to achieve balance of covariates. After matching, the significance of

statistical differences were measured through inferential statistics. The .05 significance level was selected for data analysis. The independent variable was dual enrollment participation. The dependent variables were participation in remediation, number of credit hours earned in the first semester of college, first semester GPA, first year GPA, persistence to the second year, cumulative GPA at graduation, graduation in 2 years, and graduation in 3 years. The matching procedure controlled all observable covariates to eliminate self-selection bias in the study: gender, race/ethnicity, high school GPA, ACT English score, ACT math score, ACT reading score, ACT science score, ACT composite score, student status with regards to financial aid (dependent or independent), Pell award level (none, some, full), and parental educational attainment measured by whether the student had at least one parent with a college degree or more.

Eight research questions directed this study. Each research question had a corresponding null hypothesis. Research questions 1, 5, 7, and 8 were analyzed using a series of weighted chi-square procedures. Research questions 2, 3, 4, and 6 were analyzed using a series of weighted independent samples Welch's unequal variances *t*-tests. The independent variable was dual enrollment participation. The dependent variables were rates of remediation, number of credits earned in the first semester, first semester GPA, cumulative GPA for first and second semesters, rates of persistence to the third semester, cumulative GPA at graduation, and rates of completion in 2 years and 3 years.

### Summary and Discussion of Findings

The analysis for Research Question 1 indicated a strong negative correlation between dual enrollment participation and remediation in the first semester of college. A weighted chi

square test of independence was used to evaluate the relationship between dual enrollment participation and remediation. Dual enrollment participants were almost four times less likely to need remediation at the start of college as compared to non-dual enrollment participants.

As noted in the literature review, many high school graduates come to college needing at least one remedial course (An, 2013a; Karp et al., 2007). The national average for remediation at all institutions recently was 28% (An, 2013b). An (2009) has also reported that first generation college students who participated in dual enrollment were 27% less likely to take remedial courses. In 2007, then President William Locke released statistics on remedial work at Northeast State Community College (Wagner, 2007). Between 2003 and 2006 nearly 70% of area high school graduates required coursework below college level. The population for this study was greatly constrained, requiring full time enrollment and ACT and FAFSA completions, so this previous statistic could not be assessed within this study. However, despite these high requirements for the population and the statistical control for confounding factors like parental educational attainment and academic ability, this study found a significant decrease, nearly fourfold, in the need for remediation when students took dual enrollment courses.

The analysis for Research Question 2 indicated a strong positive correlation between dual enrollment participation and the number of credits earned during the first semester of college. A weighted independent samples Welch's unequal variances *t*-test was conducted to determine if there was a significant difference in the mean number of credits earned in the first semester based on dual enrollment participation. Dual enrollment participants earned almost 1 additional credit hour (.91) above non-dual enrollment participants.

Most college students (69%) are not completing a sufficient number of credit hours per semester to finish on time (Complete College America, 2013). Increasing the time to degree

means that all parties pay more for college, the student enters the workforce later, and fewer students make it into and out of college because of systemic capacity (Complete College America, 2013). Allen and Dadgar (2012) noted a significant difference in the number of credit hours earned in the first semester by dual enrollment participants. This research question followed up on Allen and Dadgar's findings. Data analysis confirmed a credit advantage in the first semester of college for dual enrollment participants. Moreover, An (2009) noted that over the course of a bachelor's degree dual enrollment students earned 10.8 more credit hours than non-dual enrollment peers. If the 10.8 hour credit advantage were averaged over the traditional 12 semester timeline of a bachelor's degree hour (assuming 6 years to degree), the extra credits per semester would be very close to the finding in this study of a .91 credit hour advantage for community college students.

The analysis of Research Question 3 indicated a strong positive difference between dual enrollment participation and first semester GPA. A weighted independent samples Welch's unequal variances *t*-test was conducted to determine if there was a significant difference in the mean first semester GPA of first-time, full-time college students based on dual enrollment participation. Dual enrollment participants on average finished the first semester of college with a 0.24 GPA advantage over non-dual enrollment participants.

The literature largely agreed that dual enrollment students had a higher GPA in the first semester of college (An, 2009, 2013b; Allen & Dadgar, 2012; Karp et al., 2007). Karp et al. (2007) had found a 0.13 GPA positive benefit for dual enrollment participants. An (2013b) found a GPA benefit specifically for first generation students. The 0.24 GPA advantage for dual enrollment participants at Northeast State is larger than previous reported effects, keeping in



mind that the literature usually investigated outcomes at four year institutions more often than community colleges.

The analysis of Research Question 4 indicated that there was no significant difference between the first year cumulative GPA of dual enrollment participants and the first year GPA of non-dual enrollment participants. A weighted independent samples Welch's unequal variances *t*-test was conducted to determine if there was a significant difference in the mean first year GPA of first-time, full-time college students based on dual enrollment participation. Dual enrollment participants had a very small (.01) and insignificant GPA advantage.

Karp et al. (2007) found that dual enrollment students in Florida earned a significantly higher GPA in the first year of college (0.56). An (2009) reported a 0.17 GPA positive benefit in the first year of college for dual enrollment participants. This study did not find a significant difference between dual enrollment students and non-dual enrollment students. If the population had included more of the student population, for instance part time students, there may have been some significance. There may be a greater difference at 4 year institutions as well. However, for first-time, full-time freshmen at a community college that exhibited an interest in aid or scholarships by completing a FAFSA and taking the ACT, there was no significant difference.

The analysis of Research Question 5 indicated that there was no significant difference in persistence to the second year of community college between dual enrollment participants and non-dual enrollment participants. A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference in the rates of persistence to the second year between students who participated in dual enrollment and students who did not participate in dual enrollment. Dual enrollment participants were no more likely to persist to the second year of college than non-dual enrollment participants.

There is wide support that dual enrollment has a significant positive relationship with persistence to the second year of college (Giani et al., 2014; Karp et al., 2007; Swanson, 2008). Struhl and Vargas (2012) found that dual enrollment students were twice as likely to persist to the second year of college. However, Allen and Dadgar (2012) could not establish a significant difference in retention to the second year of college between students who participated in dual enrollment and those who did not. In a study at a South Carolina community college, D'Amico et al. (2013) found that dual enrollment students who took career and technical education courses in high school were more likely to persist to the second year of community college, while students taking university parallel dual enrollment were not more likely to persist to the second year than non-dual enrollment students. This study did not differentiate career and technical dual enrollment from university parallel dual enrollment and did not find a significant difference in persistence to the second year between dual enrollment participants and non-participants. There is also the open question as to whether the students who left the community college continued at another institution and whether dual enrollment might have had an effect in that population.

The analysis of Research Question 6 indicated that there was no significant difference between the cumulative GPA at graduation between dual enrollment participants and non-dual enrollment participants. A weighted independent samples Welch's unequal variances *t*-test was conducted to determine if there was a significant difference in the cumulative GPA of first-time, full-time college students based on dual enrollment participation. In fact, dual enrollment participants earned marginally lower cumulative GPAs than non-dual enrollment participants (-0.07).

The literature reviewed did not address cumulative GPA at graduation. Given that silence, this research question was intended to add to the literature. The lack of significance does

indicate that the GPA effect of dual enrollment may well be a temporal benefit that does not register as non-dual enrollment peers acclimate to college. Given that most dual enrollment students do not matriculate to community colleges, it may be that any long range benefit to GPA is seen at four year institutions.

The analysis of Research Question 7 indicated a significant positive difference in the rate of graduation in 2 years in favor of dual enrollment participants over non-dual enrollment participants. A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference in the rates of completion within 2 years between students who participated in dual enrollment and students who did not participate in dual enrollment. Dual enrollment participation and completion in 2 years were found to be significantly related; dual enrollment participants were 2.5 times more likely to graduate in 2 years.

Bailey, Hughes, and Karp (2002) speculated that dual enrollment should save time in college. Since 2002, many researchers have established a significant advantage for completion enjoyed by dual enrollment participants (Adelman, 2004; An, 2013b; Giani et al., 2014; Karp et al., 2007; Morrison, 2008; Struhl & Vargas, 2012). Thacker (2014) noted that dual enrollment students on average finished college one half a semester sooner than non-dual enrollment students. The typical measure of completion time is 150% of degree time, which is typically three years for community college students. This research question captured those students that were focused and disciplined to complete degrees within the stated degree time and assessed whether dual enrollment participants differed significantly from non-dual enrollment participants. The significant finding of this study regarding completion in 2 years for dual

enrollment participants as compared to non-dual enrollment participants is relevant to the completion-driven strategists.

The analysis of Research Question 8 indicated a significant positive difference in the rate of graduation in 3 years in favor of dual enrollment participants over non-dual enrollment participants. A weighted chi square test of independence was used to evaluate the null hypothesis that there is no significant difference in the rates of completion within 3 years between students who participated in dual enrollment and students who did not participate in dual enrollment. Dual enrollment participation and completion in 3 years were found to be significantly related; dual enrollment participants were 1.68 times more likely to graduate in 3 years.

Given the discussion above for Research Question 7 above, it should be noted that Struhl and Vargas (2012) found that dual enrollment participants were 1.7 times more likely to graduate college and this benefit applied to students at both 2- and 4-year institutions. Morrison (2008) found that dual enrollment participants were 61% more likely to finish an associate's degree. This study establishes a significant completion advantage for dual enrollment students in the State of Tennessee.

## Conclusions

The purpose of this study was to explore the relationship of dual enrollment course participation by comparing first-time, full-time traditional community college students who participated in dual enrollment ( $N=246$ ) to peers ( $N=986$ ) who did not participate. Dual enrollment participation was defined as taking one or more dual enrollment courses. The population for this study ( $N=1,232$ ) included first-time, full-time students who graduated from public high schools in the service area of Northeast State Community College over a five year span from 2008 through 2012. Propensity score matching was utilized to eliminate self-selection bias by controlling for confounding covariates such as parental education, high school GPA, and ACT scores.

The major findings of the study included the following: Dual enrollment participants (a) were nearly four times less likely to take remediation than non-participants, (b) earned approximately 1 extra credit hour in the first semesters of college, (c) earned higher first semester GPAs, (d) were 2.5 times more likely to graduate in 2 years (100% of degree time), and (e) were 1.68 times more likely to graduate in 3 years (150% of degree time). The study concluded that dual enrollment benefits community college students in Tennessee both at the beginning and completion of college. This is a significant justification for the current investment in dual enrollment by the State of Tennessee and for further increasing access to dual enrollment for all students, especially for students that live in rural areas, experience poverty, or are underrepresented in higher education.

## Recommendations for Practice

### Dual Credit Terminology

As indicated in Chapter 1, terminology surrounding dual enrollment has varied in some instances, however, the definitions of dual enrollment given by the federal government and the state of Tennessee have remained equivalent over time. For the purposes of this study, the legal definition of dual enrollment in the State of Tennessee was used. On the other hand, dual credit has had a different meaning at the federal level and in many states in contrast to the state of Tennessee. I recommend that the definition of dual credit in Tennessee be aligned with the rest of the nation to mean an arrangement whereby high school credit is awarded upon the completion of dual enrollment coursework. Such alignment would reduce confusion and facilitate research comparing Tennessee to other states or the nation as a whole.

### Improved Data for Research

One of the challenges in researching dual enrollment is the temporal compromise of data. Most of the academic markers available to researchers were recorded during or after dual enrollment participation. Neither ACT nor even a cumulative GPA from high school can indicate the student performance before dual enrollment participation. Capturing GPAs prior to and early in high school can provide researchers with a benchmark for prior performance to dual enrollment. Other standardized tests, including TCAPs, could enrich the data for analysis. I propose that a statewide educational attainment database be established to track students throughout their education from preschool through postdoctoral work. This recommendation arose from the literature review. Several states have such databases. Research has been produced to inform public policy in those states and nationally (Karp et al., 2007; Struhl & Vargas, 2012).

Other data points for dual enrollment specifically include specific coursework, the status of the course instructor, and the mode and location of the course.

### Improved State Reporting

While preparing for this study, I was initially impressed with the statistical data available in a variety of publications, though as I compiled the information I began to realize that it is very difficult to get a holistic picture of dual enrollment in Tennessee. The most helpful publication was the *2012 Tennessee Education Lottery Scholarship Special Report: An examination of grant and loan forgiveness programs for special populations* (THEC, 2012). Even with this publication, I could not confidently arrive at a deduplicated number of students taking part in dual enrollment. I estimated 2,780 in 2010-11, which would mean that the participating students were on average taking 6 courses of dual enrollment, which appears unlikely as a population average. It was impossible to estimate how that was distributed among ethnicities and socioeconomic levels within the participants. I recommend that a report be produced annually that is more comprehensive and descriptive of participation in lottery funded programs, including dual enrollment.

### Dual Enrollment Grant Proposals

The dual enrollment grant structure that has taken effect this fall of 2015 partially addresses the inequities of the current grant policy by increasing the grant amount for the first 2 dual enrollment courses and shifting some out of pocket costs to later coursework. This may have a positive effect on broader participation in dual enrollment, though it does not address fees, textbooks, or the additional expenses of career and technical courses in dual enrollment.

Furthermore, it may discourage students from taking anything more than 2 dual enrollment courses and instead encourage them to wait until the courses are offered freely at a community college nearby after matriculation.

I would like to note that any change in the dual enrollment grant and other scholarships must minimally preserve the positive gains that have been accrued to date through lottery funding. College tuition in Tennessee is competitive among SREB states in terms of 4 year tuition (THEC, 2014a) and Tennessee is ranked 3<sup>rd</sup> in the nation for grant aid to students. The level of debt incurred by Tennessee students during college is much lower than the national average; Tennessee enjoys the 7<sup>th</sup> lowest student debt level among the states. The lottery scholarships were implemented as aid to qualified students of all socioeconomic status for a particular purpose. That purpose was to retain quality students in state both for the economic boost of the college years in goods and services and a hope that going to school in state would help those students remain in the state permanently. The statistics of students remaining in state for college have shown a notable increase, moving from around 81% before the implementation of the lottery scholarships to about 84% (THEC, 2014a). Given a statewide cohort of 69,500 students, this would net about 2000 extra students remaining in state each year. There are no statistics directly connecting dual enrollment grant participation to this in-state retention of students, however, more than one third of the dual enrollment grants were utilized by households with an annual income above \$84,000 – the assumption that the dual enrollment grant is related to this positive trend is realistic (THEC, 2012). Not only is Tennessee retaining more students in-state, but more students who have exceptional scores on the ACT are attending our universities (Blakely, 2011; Broden, 2015). Expanding opportunity based on merit has benefited



the state. These positive gains may bring Tennessee into a position of leadership for educational attainment in the next two generations.

State statistical data supports the enlargement of dual enrollment grants to increase participation among all students - even affluent and academically prepared students. When comparing dual enrollment grant recipients to TELS recipients, dual enrollees tend to have a higher GPA, more often have both a 3.0 high school GPA and at least a 21 on the ACT, are more often eligible for a merit scholarship (8% vs 5%) , and are less likely to require remediation 12% vs. 19% (THEC, 2012). Dual enrollment grant recipients are also more likely to retain their TELS scholarships in the second year of college.

While increasing the participation of all, state leadership must not neglect to increase equity of opportunities for students that are living in rural areas, poor, or underrepresented. Participation in dual enrollment and use of the dual enrollment grant is strongly correlated with attending a high school near a participating institution (THEC, 2012), thus rural counties, which are more likely to have low income students are at a disadvantage to offer dual enrollment. I recommend that ITV delivery should be leveraged to increase dual enrollment at rural schools or that some additional state funding should make it economically feasible to offer dual enrollment face to face in less populated areas.

An effort must also be made to recruit more impoverished students and minority students into dual enrollment. If the socioeconomic and demographic face of college is to change, it should begin in dual enrollment as the natural connection between high school and college. The demographics of dual enrollment should look like the desired demographics of college completion – which in turn should look like the population of Tennessee. Encouraging participation among disadvantaged students may be best accomplished by reducing what is

required to enroll in terms of money and time. Minimally, I recommend that the dual enrollment grant should be expanded to include an additional needs based grant amount for low income students which would cover any gap fee, additional fees and text books. Also, additional funding for career and technical dual enrollment programs that result in certifications prior to college should also be considered. Addressing these inequities would truly make dual enrollment available for as many students as possible in every social group and every county of the state.

To further increase access and the mainstreaming of dual enrollment participation, I recommend creation of a standard block of classes in a program called First Semester, which would be a subset of the core curriculum for undergraduate degrees that would be available to earn a full semester of credit in a block during one school year. Currently, the parents of students must reapply each semester for the dual enrollment grant via computer. I recommend eliminating the computer registration requirement for parents and the need for reapplication each semester. As long as the student grades are sufficient to maintain dual enrollment participation, there should be no need to make parents apply more than once. This study has already established that dual enrollment impacts timely completion of college. A structured first semester of credit toward a degree could decrease time-to-degree even more. While this does not directly address the equity issues, it does simplify the process for families and would help those first generation students who did avail themselves to this program. Because the commitment is longer, it would merit more promotion and direct appeal to students and parents to raise awareness of the availability and benefits of dual enrollment among disadvantaged groups.

#### Recommendations for Further Research

This study examined the relationship between dual enrollment participation and outcomes at a single community college using a rigorous statistical method to control for self-selection

bias. Expanding the scope of a study like this to Tennessee community colleges, Tennessee regional universities, and indeed, the whole of Tennessee public higher education would all be worthy studies to undertake. A study of dual enrollment effects throughout the whole Tennessee Board of Regents ecosystem including transfers between institutions could prove highly beneficial in establishing the profound benefits of dual enrollment for reducing remediation and increasing timely completion, as this study has firmly established at one community college.

This study was framed with dual enrollment as a treatment requiring only one class to achieve an effect. An (2013a) posited that a single dual enrollment class was not beneficial. This study could be reframed to compare the relationship of dual enrollment to college outcomes for those with no dual enrollment, one course, or two courses and more. Were that to be true, then the findings of this study are likely overstated for students with one dual enrollment course and understated for students with two or more dual enrollment courses.

Another study that deserves attention is the grant funded efforts of the Niswonger Foundation (2015) and its 15 school system partners to improve college readiness. Dual enrollment was only a part of this \$21 million grant, yet there was an explosion of dual enrollment offered in the partner systems. A study to determine the effect of the grant on college going, college readiness, and college completion would be highly beneficial. If the program increased participation among disadvantaged students it could provide a significant justification for expanding dual enrollment and other programs to promote college and improve college outcomes.

Further research in to the findings of Adelman (2006) and Swanson (2008) for Tennessee students should be completed. Adelman (2006) noted a significant increase in completions for students who earned 20 hours credit total before the end of the first year of college and suggested

using dual enrollment to help students meet that mark. Swanson (2008) built on Adelman's discovery of the 20 hour threshold. Swanson incorporated this "nest egg" of credit (p. 82) with two other factors: enrollment in college no more than seven months after graduation and persisting through the second year of college with no more than one semester of not taking classes. These three markers together comprised academic momentum. Students who participated in dual enrollment maintained academic momentum at a significantly higher rate. Research into the following measureable markers would benefit decision makers in Tennessee: Does dual enrollment and the 20 hour threshold hold true for Tennessee students? Does dual enrollment participation significantly academic momentum and impact outcomes in Tennessee?

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## APPENDICES

### APPENDIX A

ETSU IRB Approval (Received June 30, 2015)



EAST TENNESSEE STATE  
UNIVERSITY

Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707  
Phone: (423) 439-6053 Fax: (423) 439-6060

August 24, 2015

John Mark Grubb  
808 Way Cross Road  
Church Hill, TN 37643

Dear John,

Thank you for recently submitting information regarding your proposed project "Dual Enrollment and Community College Outcomes: A Quasi-Experimental Study."

I have reviewed the information, which includes a completed Form 129.

The determination is that this proposed activity as described meets neither the FDA nor the DHHS definition of research involving human subjects. Therefore, it does not fall under the purview of the ETSU IRB.

IRB review and approval by East Tennessee State University is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are human subject research in which the organization is engaged, please submit a new request to the IRB for a determination.

Thank you for your commitment to excellence.

Sincerely,  
Stacey L. Williams, Ph.D.  
Chair, ETSUIRB



*Accredited Since December 2005*

APPENDIX B

NESCC IRB Approval (Received July 13, 2015)



# Memo

**To:** John Grubb, Librarian  
**From:** Connie R. Church, Director, Research and External Reporting  
**Date:** July 13, 2015  
**Re:** Northeast State Dissertation Approval

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Northeast State hereby grants final approval for you to base your dissertation study, "Dual Enrollment and Community College Outcomes: A Quasi-Experimental Study," on Northeast State data.

*Connie Church*      *7-13-2015*  
\_\_\_\_\_  
Connie R. Church      Date

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APPENDIX C: Significance Findings Comparison Between Methods

There were several matching methods available in the MatchIt package of R (Ho et al., 2013). All of the methods were ran. The number of control cases varied. However, the impact of dual enrollment on completion abided through all of the analyses.

Table 10  
*Matching Methods Count of Treatment and Control Cases*

Matching Method	Sum of ABS Mean Diff's	TreatCount	ControlCount
Unmatched	7.4186	246	986
Optimal Ratio=3:1	3.6191	246	738
Subclass	1.5044	246	986
Full	0.7948	246	986
Optimal Ratio=1:1	0.7791	246	246
Optimal Ratio=2:1	0.6928	246	492
Nearest Ratio =1:1	0.6734	246	246
Genetic Ratio =2:1	0.1858	246	334
Genetic Ratio =1:1	0.1204	246	193

Table 11  
*Significance of Research Questions by Descending Sum of Absolute Mean Differences*

Matching Method	RQ1	RQ2	RQ3	RQ4	RQ5	RQ6	RQ7	RQ8
Unmatched	SIG***	SIG***	SIG***	SIG***	SIG***	SIG***	SIG***	SIG***
Optimal Ratio=3	SIG***	SIG***	SIG***	SIG*	SIG*	-	SIG***	SIG***
Subclass	SIG***	SIG**	SIG***	-	-	-	SIG***	SIG***
Full	SIG***	SIG**	SIG**	-	-	-	SIG***	SIG***
Optimal Ratio =1	SIG**	SIG*	SIG*	-	-	-	SIG***	SIG*
Optimal Ratio =2	SIG***	SIG**	SIG**	-	-	-	SIG***	SIG**
Nearest Ratio =1	SIG***	SIG**	SIG**	-	-	-	SIG***	SIG***
Genetic Ratio =2	SIG*	-	SIG*	-	-	-	SIG***	SIG*
Genetic Ratio =1	-	-	-	-	-	-	SIG***	SIG**

\*(p<.05), \*\*(p<.01), \*\*\*(p<.001)

VITA

JOHN MARK GRUBB

Education: Hiwassee College, Madisonville, Tennessee;  
Associate of Arts in Music;  
1985

University of Tennessee, Knoxville, Tennessee;  
Bachelor of Music in Composition;  
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University of Tennessee, Knoxville, Tennessee;  
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2000

East Tennessee State University, Johnson City, Tennessee;  
Doctor of Education in Educational Leadership;  
2015

Professional Experience: Library Assistant I,  
East Tennessee State University, Johnson City, Tennessee;  
1991-1996

Library Assistant III,  
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