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# College Credit in High School: An Examination of the Impact of Dual Credit on College Success and Completion in Texas

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# College Credit in High School: An Examination of the Impact of Dual Credit on College Success and Completion in Texas

**by**

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# Dedication

To my parents and sisters.

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# College Credit in High School: An Examination of Dual Credit on College Outcomes in Texas

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Abstract: Dual credit, which allows students to simultaneously earn high school and college credit for the same course, is widely-implemented across the country. Dual credit is thought to promote student success in higher education. However, there is limited research on whether dual credit courses taken in high school positively influence college-level outcomes. Using Ordinary Least Squares and Logistic analysis to control for student background characteristics, this study examines the relationship between dual credit and student success in college, specifically freshman grade point average and college graduation. The study examines an existing dataset from the Texas Higher Education Coordinating Board that includes approximately 35,870 students. Results suggest that dual credit positively influences college outcomes.

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# Chapter 1: Introduction

What is the difference between high school and college? Most answers to this question describe a difference in academic rigor by pointing out that college is considered "harder" than high school. What about when high school students take college courses and earn college credit? Some people fully support the idea while others are uncertain or unconvinced. Either way there would be many opinions both for and against the practice, which is known as dual credit and which is a common practice throughout the United States.

Dual credit, which allows students to simultaneously earn high school and college credit for the same course, is widely-implemented across the country. Government and education leaders believe that dual credit promotes student success and organizational productivity in higher education. However, the amount of dual credit research is limited. Therefore, the claims that dual credit courses enhance student academic performance and in turn, support institutional efficiency and effectiveness remain largely untested. In light of the growing interest in dual credit, this study employs a quantitative research design to investigate whether dual credit impacts key college-level outcomes which are indicators of student success.

This chapter begins with background information, including a discussion of dual credit terminology and an overview of the growth of dual credit. In addition to providing context for how these programs evolved, this discussion provides a brief introduction to dual credit literature. The chapter continues with a statement of the problem and the purpose of the study. The research questions, significance of the study, and methodology follow. The chapter concludes with definitions of terms that will be used in the study and an overview of the study.

# Overview

Major changes have occurred in the United States that impact education and the workforce. The nation's demographics have shifted and the economy has become knowledge-based and globalized. As a result, education and the workforce are much more diverse, and employers are seeking workers with postsecondary degrees and specialized skills. Meanwhile, K-12 and higher education funding has been significantly reduced as a result of financial circumstances across the country (Sanchez, 2011; Texas Higher Education Coordinating Board, 2011b). This combination of economic and demographic changes increases the pressure on schools which are now expected to serve more students with fewer resources.

In this era of decreased financial resources, leaders and policymakers are calling for increased accountability in public education. Colleges and states are examining data, monitoring student outcomes, and developing completion agendas designed to improve educational attainment. One area receiving considerable attention is the gap between college access and success for students who are underrepresented in higher education including low-income, minority, and first-generation students. Underrepresented students have greater access to college than ever before, but they also have much lower rates of persistence and degree completion than their peers (Lederman, 2012).

Some institutions of higher education and policy makers have focused on providing services and support (such as tutoring, mentoring, and summer bridge programs) to underrepresented students in order to encourage them to persist and graduate from college. Other education stakeholders, particularly legislators and state education agencies, are promoting efforts to increase the productivity of institutions of

higher education. Many of these initiatives focus on the role of finances and seek to incentivize both students and institutions to behave in ways that save money.

One way to increase efficiency and effectiveness in education is through collaboration between the K-12 sector and higher education institutions (University of Virginia, 2010). Dual credit is one type of K-12 and postsecondary collaboration that is widely-implemented across the United States. The means by which dual credit courses are implemented varies by state, but most programs are developed through local partnership agreements between high schools and two- or four-year colleges. The basic premise of dual credit is that offering college courses at the secondary level increases rigor in high school, thereby allowing students to become more prepared for college. Students with more academic preparation tend to be successful in college. Colleges and universities that enroll dual credit students are likely to have higher rates of persistence and graduation, which are used as metrics for efficiency and effectiveness. Therefore, dual credit positively influences student outcomes, which promotes productivity among institutions of higher education.

Success in college has been linked to rigorous course-taking in high school (Adelman, 1999). Dual credit increases the rigor and intensity of high school curriculum by allowing students to engage in college-level learning in high school. The enhanced level of rigor and expectation in dual credit courses provides underrepresented students with academic skills and experiences that are necessary for success in college. Therefore, dual credit is considered particularly beneficial for underrepresented students.

Colleges and universities with high levels of student persistence and graduation are considered both efficient and effective. Therefore, institutions of higher education and state leaders are seeking ways to promote these goals. Dual credit is one of the most widely-used mechanisms for increasing rigor in high school with the goal of improving

student outcomes in college and college productivity. As a result, dual credit has grown dramatically and has received considerable positive attention from policymakers and practitioners in recent years. In spite of the attention and support dual credit has received, there is not one agreed-upon term used to describe the practice.

**DUAL CREDIT TERMINOLOGY.** One of the challenges of implementing, researching, and even discussing dual credit, is the variety of terms used to describe the practice. Dual credit, dual enrollment, concurrent enrollment, college in the high school, and college-level learning in high school are all different terms that have been used to refer to the same practice: a high school and a college allowing students to enroll in college courses and earn high school and college credit simultaneously (Hoffman, Vargas, & Santos, 2009; Hughes, Karp, Bunting & Friedel, 2005; Johnstone & Del Genio, 2001; Karp, Calcagano, Hughes, Jeong & Bailey, 2007; Kim, 2006; McMannon, 2000). There is no consistently agreed-upon language for dual credit (Boswell, 2001; Kim, 2006). According to one early literature review (McMannon, 2000), the absence of generally accepted or consistent language to describe dual credit reflects the wide variety of policies, purposes, and logistical arrangements that are employed in awarding this type of credit. Thus, the variety of ways that dual credit is described and defined arises from the many ways it is implemented in different states and by various institutions of higher education.

The efforts to define dual credit include statements about what it is and what it is not. For example, some definitions differentiate dual credit courses from programs such as Advanced Placement (AP) and International Baccalaureate (IB). Whereas dual credit allows students to earn transferable college credit upon successful completion of a course, AP and IB courses require students to take an exam and each institution of higher education determines what score a student must obtain on the exam to receive college

credit (Johnstone & Del Genio, 2001). Some definitions of dual credit purposefully included or exclude specific program features or terminology whereas others are broad and designed to encompass many different variations.

According to the U.S. Department Education, dual credit is the practice of allowing high school students to earn both high school and postsecondary credits for the same course (National Center for Education Statistics, 2009). This broad definition does not specify whether courses are taught on the high school or college campus, whether they are taught by high school teachers or college professors, or if they are taught during or after the regular high school day or calendar year. However, many other organizations, including education agencies and non-profit organizations, have developed a variety of terms and definitions that reflect variations in the implementation of dual credit courses in different parts of the country.

The National Alliance for Concurrent Enrollment Partnerships (NACEP) promotes the term "concurrent enrollment" and uses a very specific definition designed to differentiate it from similar programs, such as dual credit and dual enrollment. However, NACEP acknowledges that variations exist within these programs and notes that "concurrent enrollment programs may have some elements or characteristics of the [other] programs" (NACEP, 2011). This statement acknowledges the complex array of dual credit programs and demonstrates the difficulty of developing a single definition that succinctly articulates the various ways in which dual credit is implemented across the country. These differences occur not only at the national level, but also at the state level.

In Texas there are two separate state education agencies; the Texas Higher Education Coordinating Board (THECB) oversees colleges and universities while the Texas Education Agency (TEA) provides guidance for K-12 school districts. Each agency has separate administrative rules and definitions for dual credit (Dual Credit

Partnerships Rule, 2003; High School Credit for College Courses Rule, 1996). The Coordinating Board defines dual credit as "a process by which a high school junior or senior enrolls in a college course and receives simultaneous academic credit for the course from both the college and the high school" (Texas Higher Education Coordinating Board, 2010, April). The Texas Education Agency describes dual credit as "a process through which a student may earn high school credit for successfully completing a college course that provides advanced academic instruction beyond, or in greater depth than, the Texas Essential Knowledge and Skills (TEKS) for a corresponding high school course" (Texas Education Agency, 2011, February 23). The two state agency definitions are broadly constructed and complementary, but they are not identical.

The different definitions used by TEA and the Coordinating Board can be confusing, depending upon one's level of understanding and knowledge of dual credit. TEA's definition focuses on exceeding the requirements for a high school course while the Coordinating Board emphasizes that juniors and seniors take dual credit. Both definitions describe dual credit as a process that allows students to earn high school and college credit, but each state agency's definition differs slightly. As a result, there is not one agreed-upon definition used by both high schools and colleges in Texas.

As described above, the U.S. Department of Education's definition explains that dual credit allows high school students to earn high school and college credits simultaneously through the same course. In addition to summarizing the common elements of both definitions used in Texas, the federal definition uses the term "dual credit". To provide clarity and consistency, this study uses the federal definition of dual credit which is the practice of allowing high school students to earn both high school and postsecondary credits for the same course.

**GROWTH OF DUAL CREDIT.**

Dual credit programs were initially created for advanced high school students, but the context has changed significantly in recent years. Today "educators assume that dual [credit] participation can have additional benefits and should include a wider range of students, with the ultimate aim of improving student access to, success in, and completion of college" (Karp and Jeong, 2008, p. i). Thus, dual credit is now considered a strategy for engaging and accelerating students who are middle- and in some cases low-achieving as well as underrepresented in higher education (Bailey and Karp, 2003; Bragg, Kim and Rubin, 2005; Clark, 2001; Hoffman, 2005; Karp, Bailey, Hughes, and Fermin, 2004; Lerner and Brand, 2006; Michelau, 2006).

As the idea of accelerated learning for high school students has been advanced, enrollment in dual credit has grown significantly. Historically, the most widely-cited national enrollment numbers on dual credit came from two National Center for Education Statistics reports on the 2002-2003 school year. As of that year, 71% of high schools in the United States offered dual credit, and there were an estimated 1.2 million enrollments in dual credit courses at these high schools (Waits, Setzer, and Lewis, 2005). Meanwhile, 57% of all institutions of higher education had high school students taking courses for college credit (Kleiner &Lewis, 2005).

The National Center for Education Statistics updated these studies based on data from the 2010-2011 school year. As of that year, 82% of high schools offered dual credit, and there were 2 million students enrolled in dual credit (Thomas, Marken, Gray & Lewis, 2013). And, 53% of institutions of higher education reported that high school students took courses for college credit (Marken, Gray & Lewis, 2013). A comparison of national statistics from 2003 to 2011 demonstrates that dual credit has grown, both in terms of the number of high schools offering dual credit and in the number of student

enrollments. However, the number of institutions of higher education offering dual credit has decreased slightly (from 57% to 53%). A number of state-level studies also provide additional perspectives and statistics on dual credit.

Bragg, Kim, and Rubin (2005) found that dual credit was present in all 50 states, with approximately half of the states using policy or legislation to mandate that students have access to dual credit courses. The nationwide increase in dual credit enrollment has been so significant that the literature describes the growth using terms such as "rapid," "unregulated," "dramatic," and "explosive" (Bailey & Karp, 2003; Clark, 2001; Griffith, 2009; Johnstone & Del Genio, 2001; Kirby & Bragg, 2006). For example, in Texas, enrollment in dual credit quadrupled between 1990 and 2002 (O'Brien & Nelson, 2004), and it grew from 25,933 in 1999 to almost 200,000 in 2009-2010, an increase of 668% over 10 years (Texas Higher Education Coordinating Board, 2010).

Both in Texas and across the country, dual credit course-taking has expanded through two mechanisms: legislative codification and enrollment growth. States have developed policies and enacted legislation in support of dual credit. As a result, dual credit has gained formal recognition as a mechanism for accelerating high school students' academic programs. Meanwhile, the number and type of students enrolling in dual credit has increased as it has become part of the regular high school curriculum. The fact that dual credit has become a common element of high school curriculum is demonstrated by the growth of three programs that will be discussed in the next chapter: Project Advance, Middle College High School, and Early College High School. As these programs expanded and produced results for high- and middle-achieving students, other colleges and school districts began to emulate them. As a result, enrollment in programs that provide access to college campuses and credits grew, and state legislatures developed

laws to support and facilitate dual credit courses. In this way, dual credit has gained prominence across the country.

## Statement of the Problem

Dual credit course-taking, which allows students to simultaneously earn high school and college credit, is widely-implemented. It is thought to prepare students for college, thereby increasing efficiency and effectiveness in higher education. However, "[d]espite the popularity and growth of dual credit programs, little is known about their efficacy" (Karp, Calcagano, Hughes, Jeong & Bailey, 2007, p. 1). Growing enrollment and a limited body of research cause stakeholders to raise questions about the value and impact dual credit.

Many aspects of dual credit have yet to be researched and, as a result, have raised questions. What is the appropriate level of rigor when teaching a college-level course to high school students (Kim, Bragg & Barnett, 2003)? Does the location where dual credit courses are taught influence its impact on students? Should high schools and colleges both receive funding when a student enrolls in dual credit (Boswell, 2001; Hoffman, 2005)? Are the academic outcomes different for traditional versus online dual credit courses? All of these questions are pertinent and worthwhile for academic inquiry. However, one important question that has yet to be answered comprehensivelly is: does dual credit enhance student success in college by increasing levels of academic preparation and college graduation?

The effort to find answers to this question has been affected by the ability to conduct research on dual credit, which has been limited for a number of reasons. Dual credit spans secondary and postsecondary education. In order to obtain enough information to answer many of the research questions, data must be collected and made

available both at the high school and college levels. However, many institutions are not collecting data systematically and if so, are not sharing data between the K-12 and higher education sectors. For example, in order to determine whether dual credit impacts academic performance in college, researchers must have access to high school and college-level data. Thus, it is difficult, and sometimes impossible, to obtain enough K-12 and higher education data to evaluate the impact of dual credit on postsecondary outcomes. As a result of these factors (which will be discussed further in Chapter 2), dual credit data and research have historically been limited.

In spite of the data limitations, there is ongoing interest in conducting research on dual credit, particularly because it has implications for accountability in higher education. As education leaders are seeking ways to increase student achievement and decrease the costs of education, dual credit is a promising strategy. It is specifically promoted as a mechanism for increasing college access and success among students who are underrepresented in higher education. Given the movement toward measuring institutional productivity and allocating funding based on student outcomes rather than enrollment, the impact of dual credit on student success is an area of research that is relevant, timely, and of consequence.

## Purpose of Study

Dual credit is expanding nationally and is widely-touted as a mechanism for increasing student outcomes and institutional productivity. Texas has experienced dramatic growth in dual credit and is a state where outcomes-based funding is prominent on the policy agenda. However, there is limited knowledge of the impact of dual credit on students after they matriculate to college. Therefore, it is critical to examine the college-level outcomes of students who participate in dual credit. The purpose of this

study is to gain a better understanding of how dual credit participation affects student success at public institutions of higher education in Texas. By developing an understanding of dual credit, education stakeholders can develop policies and procedures that support student success while increasing efficiency and effectiveness.

This research is conducted using data from the Texas Higher Education Coordinating Board. Over the past few years, a new state policy in Texas (which will be discussed in Chapter 2) required all high school students in the state to have an opportunity to earn up to 12 college credit hours prior to graduation. This policy has led to a significant increase in dual credit participation in Texas. As a result, an increasing number of students are seeking to transfer a considerable number of college credits earned through dual credit. Therefore, the goal of the study is to address questions about whether dual credit contributes to student success in college by examining institutional data from the Texas Higher Education Coordinating Board.

## Research Questions

Based on the literature reviewed (in Chapter 2), the study is designed to compare outcomes for dual credit and non-dual credit students. The specific outcomes under examination are academic preparation and college graduation. There is also a particular focus on determining whether dual credit positively influences levels of student success for underrepresented students. Therefore, this study examines the following research questions:

1. Are there differences in dual credit enrollment for students who are underrepresented in higher education?
2. What is the relationship between dual credit and academic preparation, as measured by grade point average after the first semester of college?

3. How does dual credit influence the probability of college graduation?

## Significance of Study

There is ongoing interest in dual credit as a mechanism for promoting efficiency and effectiveness in higher education. The current literature, which was briefly introduced in the Growth of Dual Credit section, calls for continued investigation of dual credit courses. There are many questions about the efficacy of dual credit that are unanswered or which require additional empirical testing. One area of significant interest is the determination of whether dual credit influences college readiness and success, particularly for underrepresented students.

In order to conduct rigorous, quantitative studies of dual credit, researchers must have access to data that allows them to statistically control for students' prior academic achievement. The number of researchers who have been able to accomplish this is limited. Among the major studies that have been conducted, three included Texas data (Bragg, 2008; Kim & Bragg, 2006; Struhl and Vargas, 2012; Radunzel, Noble, & Wheeler, 2012). The limited research in Texas combined with the scant amount of literature on dual credit demonstrates the need for additional research on the topic.

In addition to adding to the growing body of literature on dual credit by conducting research in Texas, this study may have implications for state-level policy. Given the current fiscal climate and the shift toward outcomes-based funding, the research may serve as a catalyst for public colleges in Texas to examine the impact of dual credit on their student populations. Additional research on dual credit in Texas will provide institutions of higher education and the Legislature with data that can inform the funding and implementation of dual credit programs throughout the state.

# Methodology

This research is conducted with a state-level data set from the Texas Higher Education Coordinating Board that was merged and de-identified by the THECB. The data set contains 10 years of student-level admissions, enrollment, performance financial aid, and completion data, which allows the researcher to examine the effects of dual credit on college outcomes.

Each student enrolled in public higher education in Texas receives a unique identification number that was de-identified for research purposes and used to merge data across administrative data sets. The data set includes only first-time in college students. It excludes students who transferred from other colleges and any courses a student transfers after the freshman year. Admissions and financial aid records provide background information on the students, including demographic and academic characteristics. Therefore, it includes all of the elements necessary for conducting a rigorous analysis of dual credit.

As detailed in the research questions, the outcomes of interest are freshman grade point average and college graduation for dual credit versus non-dual credit students. In order to determine whether there are significant differences for underrepresented students who enroll in dual credit, the data were filtered by student sub-populations including race/ethnicity, gender, first-generation, and socioeconomic status. Multivariate regression analysis (ordinary least squares and logistic regression) were used to test the hypotheses and outcomes under investigation while controlling for student background characteristics.

Two theoretical frameworks were used to guide the research and analysis in this study: Human Capital Theory and Academic Capital Formation. These frameworks,

which will be discussed in Chapter 3, emphasize the role of academic preparation and success in college and the workforce. As such, they provide a rationale for studying the impact of dual credit on college-level outcomes.

## Limitations

There are limitations inherent to dual credit research. First, institutions of higher education require students who enroll in dual credit to meet admission requirements including, but not limited to, minimum test scores and grade point averages. As a result, dual credit students have a demonstrated level of academic ability which must be taken into account when researching dual credit. As described above, this bias is addressed through the use of multivariate regression analysis. Second, students who enroll in dual credit may have unobserved characteristics, such as higher levels of motivation or parental support than their peers. These characteristics cannot be addressed through a quantitative research design since they are unobserved.

## Definitions

Advanced Placement (AP): a proprietary high-school curriculum administered by the College Board that is considered to be rigorous and college-level. Advanced Placement includes both standardized courses and exams, which are scored from one to five. Institutions of higher education determine what score a student must earn in a subject area in order to receive college credit (College Board, 2012a).

Dual Credit: the practice of allowing high school students to earn both high school and postsecondary credits for the same course (National Center for Education Statistics, 2009).

First-generation student: A student whose parents have not attained education beyond high school (Chen, 2005)

International Baccalaureate (IB): a proprietary curriculum administered by the International Baccalaureate foundation that serves students from ages three to 19. IB focuses on providing "international education" and is considered to be rigorous. The high school component, known as the Diploma Programme, is taught over two years and culminates in a series of exams. The maximum score is 45 and students who obtain a minimum of 24 are awarded an IB diploma (International Baccalaureate, 2012).

K-12: refers to the education system from kindergarten through twelfth grade.

Texas Essential Knowledge and Skills: the state educational standards that define what students should know and be able to do at each grade level. For more information see: http://www.tea.state.tx.us/

Underrepresented students: populations of students who have limited access to and/or enrollment in higher education, including first-generation, low-income, and minority students.

## Organization of Study

This chapter, which began with background information on dual credit, provided an overview and foundation for this study, which will investigate the college-outcomes of dual credit students at public institutions of higher education in Texas. Chapter 2 considers the concept of student success, examines literature on persistence and dual credit, and details the theoretical frameworks that will be employed in the research. The first two chapters provide context for Chapter 3, which describes the data and explain the research design of the study. Chapter 4 presents the results and Chapter 5 synthesizes and discusses the conclusions.

# CHAPTER 2: LITERATURE REVIEW

## Overview

This study examines the postsecondary outcomes of dual credit students at public four-year institution of higher education in Texas. This chapter, which is organized into four sections, provides context for the study through a review of literature on student success and dual credit. The chapter begins with a brief overview of the concept of student success and then reviews literature and theories on persistence. The second part of the chapter provides a thorough overview of dual credit, including its history and role in serving underrepresented students as well as the characteristics, benefits and concerns, and data limitations associated with dual credit resesarch. The third section summarizes and synthesizes the findings from major studies that use statistical analysis to examine dual credit. The final section provides an overview of the two theoretical frameworks that will be employed in this study.

## Student Success & Persistence

From the pages of *U.S. News and World Report* to state capitals across the country, higher education institutions are operating in an era of accountability. Colleges and universities are increasingly being ranked, compared, and funded based on measurements of student success. Those institutions with the highest graduation rates, shortest time to degree, and fewest excess credit hours among students are considered more efficient and effective. In Texas, where the Legislature has moved toward outcomes-based funding, the Texas Higher Education Coordinating Board has called for "more comprehensive studies of the efficiency and effectiveness of dual credit programs" with a "focus on student outcomes including: performance of dual credit students in

subsequent, related college courses; college enrollment, persistence, completion, and graduation rates; and time-to-degree rates for certificate, associate's and baccalaureate completers" (THECB, 2012c, p. 3). Thus, student success in dual credit is increasingly being linked with institutional success.

Student success can be defined in many ways ranging from college enrollment to degree completion. As a result, student success is quantified in a number of ways including: scores on standardized entrance exams, grades, number of credit hours earned in consecutive terms, and number of semesters to degree attainment (Kuh, Kinzie, Buckley, Bridges & Hayek, 2006; Venezia et al., 2005). Each of these metrics provides distinct information that can be applied to different types of questions about student success.

### STUDENT PERSISTENCE.

One measure of student success that continues to generate significant interest among quantitative and qualitative researchers is student persistence. While it has been studied extensively and has given rise to a significant body of theory, student persistence is not readily associated with one type of metric. In fact, attempts to measure student persistence are complicated by the many different ways that students progress through educational institutions (Mortenson, 2012). There are not only multiple terms used to describe student persistence, but also to many different types of data being gathered to assess whether students are achieving specific educational milestones (Mortenson, 2012).

**Definitions of student persistence.** According to Hagedorn (2012), the most basic and non-controversial definition of a student who persists is one who enrolls in higher education and maintains enrollment until earning a degree. However, persistence is often used interchangeably with retention, even though the two terms have distinct

meanings (Hagedorn, 2012; U.S. Department of Education, 2003). Both words describe a similar concept from different perspectives. According to Berger, Ramirez, and Lyons (2012), retention is an institution's ability to retain a student from admission through graduation and persistence is "the desire and action of a student to stay in higher education from enrollment through graduation" (p. 12). Whereas retention focuses on institutions, persistence focuses on students and, according to Berger et al., it emerged as a distinct concept from retention in the 1990s. Therefore, persistence will be used throughout this study.

**Theories of student persistence.** Student persistence is one of the most widely-researched areas in higher education and it has been systematically studied from many different theoretical perspectives. Beginning in the late 1960s, researchers applied sociological and psychological frameworks to student persistence, and in so doing, began to investigate the interaction between students and their environment (e.g. Astin, 1968 and 1970; Bean & Metzner, 1985; Spady, 1970; and Tinto, 1975, 1993). Researchers have examined student persistence through a lens of institutional and organizational culture (e.g. Bean, 1980, 1983; Braxton & Brier, 1989; Berger and Braxton, 1998; Kamens, 1971). As access for underrepresented students has become a focal point in higher education, persistence has been studied from a cultural perspective (e.g. Attinasi, 1989, 1992; Kuh & Love, 2000; Pike & Kuh, 2005) Tierney, 1992; and Torres, 2003) and an economic perspective (e.g. Braxton, 2003; Cabrera, Nora, and Castaneda, 1992; St. John, Cabrera, Nora, and Asker, 2000). Persistence among first-generation and minority students has also been a major focus (e.g. Cabrera, Nora, Terenzini, Pascarella & Hagedorn, 1999; Cabrera, Burkum, La Nasa & Bibo, 2012; Terenzini, Springer, Yeager, Pascarella & Nora, 2006).

As evidenced by the many theoretical perspectives through which it has been viewed, student persistence is a rich area of scholarship. It is acknowledged that many individuals have made significant contributions in this realm of research. However, this review of literature on student persistence will focus on Vincent Tinto's interactionalist theory of student departure (1975, 1987, 1993) for the following reasons. First, it is considered a seminal work that has been described as "near-paradigmatic" in the area of student persistence (Braxton, Sullivan & Johnson, 1997; Pascarella & Terenzini, 2005). Second, it continues to be built upon by many other researchers and the scholarship it has spurred regarding student success contributes to the context in which dual credit has emerged. While this is not the theoretical framework that is used for the study, it is a logical and important point of departure for the literature review.

***Tinto's theory of student departure.*** Vincent Tinto built his theory on earlier work by Astin (1970) and Spady (1971) that identified personal and environmental factors as predictive of a student's persistence. Like Spady, Tinto employed Emilie Durkheim's theory of suicide (1951) to frame student departure as separation from a community. However, he added the work of Arnold Van Gennep (1960), a social anthropologist who studied how rituals provide for membership in a tribal society. Using these ideas, Tinto views persistence, or lack thereof, as a "longitudinal process of interactions between the individual and the academic and social systems of the college" (Tinto, 1975, p. 94). The theory outlines a three-part process including: separation from previous groups or communities, including family and friends; transition between communities and; social and academic incorporation into the new community. A student's ability to integrate into the community is influenced by academic (grades and intellectual development) and social systems (peers, faculty, and administration) that are interrelated with one another. Tinto suggests that whether or not a student persists is a

combination of individual characteristics, prior experiences, and the degree to which they integrate into the college community. This process is depicted in Figure 1, which provides a visual representation of the stages that students undergo as they transition to college.

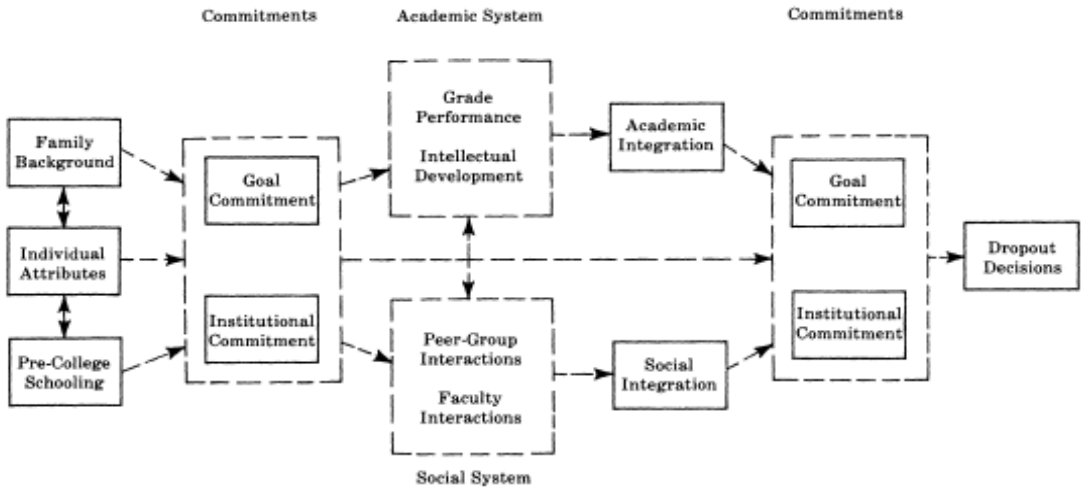


Figure 2.1: Tinto's Theory of Student Departure

Various aspects of Tinto's model have been critiqued, questioned, and expanded upon by researchers seeking to empirically test and verify its components (e.g. Bean, 1980; Berger, 2000; Braxton & Lien, 2000; Braxton, Sullivan, & Johnson, 1997; Hurtado and Carter, 1997; Kuh & Love, 2000; Nora 2001-02; Tierney, 1992). In order to provide context for the ways in which Tinto's work has contributed to scholarship on student persistence, two different responses will be considered including, Bean (1980) and Tierney (1992).

Bean (1980) critiqued Tinto's application of Durkheim's theory of suicide, arguing that there was not enough evidence to apply this theory to student attrition. Bean

proposed a new theory which suggested that the behavior of students who withdraw from college is similar to employees who leave a job. While Bean's model was similar to Tinto's, he placed greater emphasis on environmental factors. Meanwhile, Tierney (1992) questioned another aspect of the model when he asserted that Tinto failed to recognize that rituals are embedded in a cultural context; as a result, the model "assumed that student departure is a universal concept rather than a cultural category developed by the society that utilizes the ritual" (p. 610). According to Kuh and Love (2000), students may experience one broad social integration construct rather than separate academic and social experiences, as Tinto's model suggests. Despite the questions and concerns that have been raised, Tinto's model continues to spur research and discussion; it has also provided a foundation for researchers to examine the experiences of different groups of students – particularly students who are underrepresented in higher education.

# Dual Credit

### BACKGROUND

This section examines many aspects of dual credit including its history and related legislation as well as research on the topic. The literature included in this section was identified through searches of online databases including: Education Full Text, ERIC, and J-Stor. Multiple searches for peer-reviewed research were conducted using the following terms: "dual credit," "dual enrollment," and "concurrent enrollment," but results were limited. For example, searching the term "dual enrollment" in ERIC yielded 122 results, 22 of which were classified as evaluative.

Due to limited returns from databases, additional searches were conducted on the following websites in order to identify more research: the Community College Research Center, Jobs for the Future, the National Alliance for Concurrent Enrollment

Partnerships, the Texas Education Agency, and the Texas Higher Education Coordinating Board. These searches yielded additional research as well as documents designed for audiences including practitioners and policymakers. Therefore, the literature related to dual credit can be classified into three major categories: research, policy, and practice.

According to Michelau (2006), much of the literature is concentrated in the areas of policy and practice (see, for example, Boswell, 2001; Bragg, 2006; Bragg, Kim, & Rubin, 2005; Hoffman, 2005; Kim & Bragg, 2006; Hoffman, Vargas, & Santos, 2009). The presence of significant amounts of literature focused on policy and practice can be explained by the rapid expansion of dual credit across the country. As dual credit has grown, policymakers and practitioners have sought to understand the policy environment, share information about current practice, and identify obstacles and solutions to program implementation (Michelau, 2006). To this end, many government and policy organizations have produced reports and studies that define, describe, and explain the characteristics of dual credit in order to expand knowledge of the growing phenomenon. The volume of policy and practice literature demonstrates there is continued growth in and enthusiasm for dual credit, but the amount of academic research on dual credit (both quantitative and qualitative) remains limited. As a result, there are not only many unanswered questions, but also calls for more research and writing on dual credit (see Bragg, 2006; Hoffman, 2005; Hoffman et al., 2009; Karp & Jeong, 2008; McMannon, 2000; Michelau, 2006).

### HISTORY OF DUAL CREDIT

In 1955 the Advanced Placement program introduced the concept of providing college-level learning opportunities in high school. Over the past 60 years, a variety of other programs and organizations have been built on the foundation provided by AP.

These initiatives, which include Project Advance (1972), Middle College High School (1974), and Early College High School (2002), represent a spectrum of approaches to college-level learning in high school that will be discussed in greater detail. While the common element in all of three programs is that they allow high school students to enroll in college courses, they "have been implemented in various forms, with various student populations, and with varying degrees of funding, institutional and policy supports, and outcomes (Lerner & Brand, 2006, p. 5). As each of the different programs emerged, they influenced and/or were influenced by policy, academic research, and the creation of professional organizations. Therefore, this history also discusses the work of researchers who examined the intensity of high school course-taking (Adelman, 1999; McCormick & Carroll, 1999) and the establishment of a national organization focused on formalizing and professionalizing dual credit partnerships — the National Alliance for Concurrent Enrollment Partnerships.

In 1955 the College Board introduced the Advanced Placement program, which was designed to allow high-achieving students to take college-level courses and exams in order to enter college with advanced standing (The College Board, 2003). AP is a proprietary program that requires schools to develop courses which are submitted to the College Board for a course audit. The audit uses guidelines established by higher education faculty, and courses that meet or exceed these expectations are authorized to use the "AP" designation. Schools may also offer AP exams without offering the courses or participating in the audit. (The College Board, 2012a). Because students may receive college credit by taking an exam, AP is frequently described as "credit by exam". While AP is not dual credit, it is often categorized with dual credit because it provides opportunities for high school students to earn college credit.

In 1972, the first dual credit program began at Syracuse University. Known as

Project Advance, it began when administrators from six New York City high schools requested that the college help develop a program for college-bound seniors who had completed their high school graduation requirements (Project Advance, n.d.). The goal was to provide rigor and focus for seniors while using existing resources of the high school and college. With this concept in mind, administrators at Syracuse proposed that college courses be taught on the high school campus during the regular school day by trained high school teachers. When it began, Project Advance was a new concept, but "as more educators, students, and parents realized the value of college readiness and of taking actual college courses before leaving high school, the program grew" (Project Advance, n.d.). By 1974, the program included 180 teachers from 40 schools teaching more than 2,000 students; today the program serves more than 8,000 students (Project Advance, n.d.). Shortly after Syracuse University began to demonstrate success, other institutions expanded on the concept.

In 1974, LaGuardia Community College opened an innovative and new high school model on its campus known as Middle College High School (MCHS). As one of the first alternative high schools in New York city, Middle College was "designed for students who would flounder in a traditional high school setting" (Middle College High School National Consortium, 2011). The school, which sought to decrease high school dropouts and to increase college attendance and completion, was based on the idea that locating a high school on a college campus "would symbolically signal [to] these under-served students that a college education was possible and the natural, logical next step" (MCHSNC, 2011). There were no expectations that students would earn a specific number of college credits. Instead, the idea was to support and motivate at-risk students by enabling them to attend high school on a college campus.

Attendance increased, the dropout rate decreased, and Middle College High School achieved college-going rates of 85% and higher (MCHSNC, 2011). As a result, the middle college concept took root, and the Ford Foundation provided replication funding for six more schools; within 10 years more than 20 middle colleges were opened (MCHSNC, 2011). Today, there are 35 schools in 14 states which comprise a consortium that provides professional development and technical assistance to participating schools (MCHSNC, 2011). As Middle College expanded, it served two important functions. It provided a working model for demonstrating how middle and low-achieving students could benefit from being on a college campus. It also laid the groundwork for a forthcoming shift in the understanding and use of dual credit as a strategy for accelerating high school students.

The acceleration of high school students gained the attention of researchers through two separate but related studies published in 1999 that focused on college success and completion. Clifford Adelman (1999) found that the strongest predictor of college success is the rigor and intensity of a student's high school curriculum and that students who earn 20 college credit hours by the end of their first year of college are more likely to earn a college degree. Meanwhile, McCormick & Carroll (1999) found that college students who earn 12 credit hours in the first semester were more likely to persist in college and those who earned at least 30 credits within their first year of college were more likely to graduate within four years. Based on these findings, researchers, practitioners, and policymakers promoted the idea that all high school students – not just those who were high-achieving – could benefit from accelerated learning options in high school (Bailey & Karp, 2003; Bragg et al., 2005; Hoffman, 2005; Hoffman, Vargas, & Santos, 2009; Karp, Bailey, Hughes & Fermin, 2005; Lerner & Brand, 2006; Michelau, 2006).

As dual credit expanded across the country, its growth prompted the creation of a new organization. In 1999, the National Alliance of Concurrent Enrollment Partnerships (NACEP) formed "in response to the dramatic increase in concurrent enrollment courses throughout the country" (NACEP, n.d.). NACEP is a professional organization for high schools and colleges that promotes rigorous concurrent enrollment programs through accreditation, standards of excellence, advocacy, and research (NACEP, 2011). NACEP developed a definition of dual credit (discussed in Chapter 1), which outlines specific dual credit components. As this organization was growing, a new model was being developed, and it combined elements of Project Now and Middle College High School.

In 2002 the Bill and Melinda Gates Foundation launched the Early College High School (ECHS) Initiative, which sought to build high schools on college campuses and to provide underserved high school students with an opportunity to earn a high school diploma in addition to an Associate's degree or up to 60 credits toward a baccalaureate degree. While the concept of providing an opportunity to earn college credits was adapted from Project Now, the idea to locate high schools on a college campus was based on the middle college model. However, Early College High School included new ideas based on research such as that conducted by Adelman (1999) and McCormick & Carroll (1999). Students who enrolled in these high schools would be challenged to meet an ambitious goal of earning up to 60 college credits. They would also receive academic and social supports, such as tutoring, mentoring, that would help build study skills and "college knowledge". The underlying premise was that if students could learn about college while in high school and earn college credits, they would be more likely to graduate from high school, attend college, and earn a postsecondary degree. As of 2007, over 900 students had graduated from 17 early colleges across the country and more than 65% were accepted to four-year colleges (Jobs for the Future, 2007).

It is important to note that while dual credit is a component of middle college and early college, these models are distinctive from dual credit programs. The Middle College model purposefully located high schools on college campuses to motivate and encourage students; although dual credit was an option, it was not the major focus of the program. Meanwhile, Early College High School uses dual credit as a foundation upon which to build other elements of its program, and it is differentiated from dual credit in two ways. First, unlike dual credit – which typically serves high-achieving students – Early College High Schools are designed for underserved students who, without participation in the program, may not otherwise graduate from high school or attend college. Second, the program blends high school and college curriculum while providing students with a cohesive system of support structures designed to assist students and families who are not familiar with the knowledge and skills necessary to attend and succeed in college. Examples of the types of support include tutoring, mentoring, advisory programs, and summer bridge programs. Therefore, Early and Middle Colleges use dual credit as one component of their model.

One group of researchers noted that dual credit is integrated into many of the other models and "because of this, dual credit and dual enrollment take on a particularly important role in the emergence of new academic pathways" (Bragg et al., 2005, p. 30). This can be seen in the history of the various models that have been discussed. While Project Advance introduced the concept of dual credit for high-achieving students, the Middle College model demonstrated that middle and low-achieving students could benefit from exposure to a college environment. As Middle Colleges proliferated across the country, researchers found that students who met 12- and 30-hour credit thresholds during their first year of college were more likely to persist and graduate from college within four years. Then, Early College High Schools used these ideas and specifically

focused on serving students who are not typically college bound. Thus, the idea that early exposure to college and accelerated high school coursework could lead to college success – for middle-achieving students and not just high-achieving students – began to be tested and studied.

As new academic pathways emerged and the boundaries of dual credit expanded, a new way of thinking about the purpose of dual credit arose. Using the logic of equity and efficiency it was argued that "[i]f middle- to high-income students are already doing relatively well and have more resources with which to help themselves, then the focus ought to be on those without such resources (Hoffman, 2005, p. 5). In this way, dual credit grew from its origins as a specialized program for high-achieving students at Syracuse University to a program that serves students of varying levels of ability across the country.

## DUAL CREDIT LEGISLATION

In 1973, the state of Florida passed legislation designed to provide opportunities for high school students to earn college credit through multiple programs including dual credit and AP, among others (Education Commission of the States, 2001). The first statewide dual credit program was implemented in Minnesota in 1985 and was later codified by the state through the Postsecondary Enrollment Options program (Boswell, 2001). Dual credit legislation was passed in Texas in 1993, but enrollment did not begin to expand until later when additional state policies, which will be discussed in further detail, were implemented.

In 2000, the Texas Higher Education Coordinating Board approved a higher education plan for the state, entitled *Closing the Gaps* that outlined goals for increasing enrollment and completion in higher education (THECB, 2000). The plan emphasized the importance of increasing participation among Hispanics and African Americans and

recommended creating incentives and requirements for developing seamless transitions between high school, community college, and four-year colleges (THECB, 2000). Since it was written, the *Closing the Gaps* plan has served as a guiding document for efforts to increase access and success to higher education, including dual credit.

From 1995 to 2003, Texas policy allowed community colleges to receive state funding when high school students enrolled in dual credit courses. Neither school districts nor four-year institutions were not permitted to receive state funding for dual credit (and this will be discussed further in the section entitled "Efficiency and effectiveness" later in the chapter. Because dual credit students generated less funding for their school districts than traditional students, school districts tended limited access to dual credit to prevent the loss of funding (House Bill 415 Engrossed Fiscal Note, 2003). However, three pieces of legislation passed in 2003 that addressed these concerns and expanded dual credit in Texas.

One piece of legislation responded to concerns from school districts and allowed high schools and community college to receive state funding for dual credit courses (House Bill 415, 2003). By allowing both entities to receive funding, the legislature removed a financial disincentive for school districts to offer dual credit courses. A second piece of legislation, Senate Bill 258 (SB 258), increased the supply of dual credit courses by allowing four-year colleges and universities to waive or reduce tuition and fees. According to the bill analysis, by creating more dual credit providers, SB 258 would increase educational options for students and possibly result in a savings to the state by reducing the amount of time that it takes to earn a college degree (SB 258 Enrolled Bill Analysis, 2003). A third piece of legislation – Senate Bill 976 (SB 976) – created a Middle College High School pilot program for students in the 11$^{th}$ and 12$^{th}$ grade who were at risk of dropping out of school. The Middle College High School

program allowed students to attend high school on a college campus and earn both a high school diploma and an Associate degree upon graduation from high school (SB 976, 2003).

In 2005, two new pieces of legislation expanded access even further. One extended Middle College High School beyond a pilot and created a new program known as Early College High School (Senate Bill 1146, 2005). Whereas Middle Colleges focused on at-risk students in the 11th and 12th grade, early colleges would serve grades 9 through 12 (SB 1146, 2005). Meanwhile House Bill 1 (HB 1) created the College Credit Program, which required that all school districts offer high school students an opportunity to earn a minimum of 12 college credit hours beginning in the 2008-2009 school year (House Bill 1, 2006).

While dual credit began in Texas in 1995, subsequent pieces of legislation dramatically shifted the landscape. In addition to changing the funding structures and expanding the number of providers, dual credit has been made available to an increasing number of students, including those who are underrepresented in higher education.

### UNDERREPRESENTED STUDENTS AND DUAL CREDIT

Access to college has expanded to include many different groups of students who would not previously have had the opportunity to attend college. Nationally, approximately one in three college students come from families where neither parent attended college (National Survey of Student Engagement, 2005). In Texas, the number of Hispanic and African American students enrolling in public institutions is increasing (THECB, 2012a). However, research continues to show that first-generation students, particularly those who are also minorities and/or from low-socioeconomic backgrounds,

face additional obstacles not experienced by traditional students (Terenzini, Springer, Yaeger, Pascaralla, & Nora, 1996).

Persistence and graduation rates among African American and Hispanic students in Texas are lower than those of white and Asian students (THECB, 2012a). Meanwhile, first-generation students are more likely to be Hispanic, low-income, and female, and to have fewer support structures than students who are not first generation (Nunez & Cuccaro-Alamin, 1998; Saenz, Hurtado, Barrera, Wolf, & Yeung, 2007; Terenzini, Pascarella, & Blimling, 1996). They tend to enter college with less academic preparation and support and to have limited access to information about the college, either first-hand or from relatives (Riehl, 1994; Thayer, 2000; York-Anderson & Bowman, 1991; Billson & Terry, 1982, Willett, 1989). In their first year, first-generation student are more likely to take remedial courses and less likely to select a major; they also tend to earn fewer credits than other students during freshman year (Chen, 2005, U.S. Department of Education, 2001). As a result of these and many other factors, first-generation status is closely linked with lower rates of persistence (U.S. DOE, 2001). As enrollment among first-generation students has increased, researchers have identified sources of disparity and practitioners have attempted to provide first-generation students with additional support. Completion of a rigorous high school curriculum is one effective way to increase persistence rates among first-generation students (Adelman, 1999; Nunez & Cuccaro-Alamin, 1998; Warburton, Bugarin, and Nunez). "Exposure to college level work on college campuses gives disadvantaged students a vision of themselves undertaking and succeeding in postsecondary education" (Gullatt & Jan, 2003, p. 23). Thus, in addition to increasing academic performance, rigorous instruction in high school is thought to benefit first-generation students by enabling them to shift their self-perceptions. Because dual credit is one of the primary mechanisms currently being

employed to elevate rigor in high school, it is considered beneficial to underserved students. However, dual credit is not without its detractors. Therefore, the next two sections of the chapter consider the characteristics of dual credit as well as its benefits and concerns.

## CHARACTERISTICS OF DUAL CREDIT

In an effort to increase understanding of dual credit, researchers have sought to study and classify common traits of dual credit and similar programs. There are two widely-cited qualitative studies, one by Bailey and Karp (2003) and another by Johnstone and Del Genio (2001), that illustrate how researchers have examined and characterized dual credit programs. This section of the paper summarizes these two papers both because they provide a succinct overview of the complexities of dual credit and because these widely-cited papers provide a foundation upon which many other dual credit researchers have built (see, for example Edwards, Hughes, & Weisberg, 2011; Bragg, 2006; Bragg, et al., 2005; Harnish & Lynch, 2005; Hoffman, 2005; Lerner & Brand, 2006).

Bailey and Karp (2003) examine the characteristics of a number of programs – including dual credit – that allow middle and low-achieving students to earn college credit in high school. Through a literature review, interviews, and field work at 15 community colleges in seven states, the researchers seek to: identify the characteristics of various types of credit-based transition programs; determine which students are being served and; understand whether these programs increase college access and success. The authors conclude that there have been two major shifts in credit-based transition programs including the dramatic growth in the programs and the perception that offering

college-level coursework to middle and low-achieving students can increase their levels of educational attainment.

The second widely-cited study examines dual credit (and similar programs) from a slightly different perspective. Johnstone and Del Genio (2001) use data from a national sample of 451 two- and four-year institutions of higher education to examine how institutional policies at the college level either limit or promote "college-level learning in high school" (p. 8). This study considers a number of questions including: the extent of college-level courses available to high school students; the degree to which colleges and universities actively sponsor these learning opportunities; the range of attitudes about providing college-level learning opportunities in high school and; the institutional policies for transferring and applying credits toward a baccalaureate degree. Johnstone and Del Genio observe that dual credit programs "appear to be growing explosively, particularly in community colleges"; however, due to a lack of national and state-level data little is known about the effect of dual credit on student outcomes (2001, p. 37). They note that dual credit has many different stakeholders, including students and parents, high school and college educators, and policymakers. And they observe that whether or not college-level credits earned in high school are allowed to transfer and count toward college graduation depends on the selectivity of the higher education institution.

These two studies make several important contributions to the body of knowledge about dual credit. First, they provide examples of the types of frameworks that researchers have used to classify and understand dual credit. Second, both studies confirm that dual credit programs have been implemented in a variety of ways and for many different reasons. Finally, these studies corroborate the claim that as dual credit

has grown, it has expanded to serve not only high-achieving students, but also those who are middle-achieving and underrepresented in higher education.

## DUAL CREDIT BENEFITS AND CONCERNS

As dual credit enrollment has grown, the number of stakeholders – with opinions for and against the program – have also increased. The stakeholders, who represent both public and private interests, include students and families, school districts, institutions of higher education, legislators, and taxpayers. According to Johnstone and Del Genio (2001), there are markedly different rationales for participating in dual credit and "the particular operative rationale" will depend on the perspective of the stakeholder or participant (p. 58). Therefore, this part of the paper considers the benefits of dual credit and the concerns of various stakeholders that are reflected in the literature. Each section – benefits and concerns – categorizes the arguments for and against dual credit in three categories: (1) rigor and quality, (2) equity and access, and (3) efficiency and effectiveness.

**Benefits of dual credit.** Many benefits of dual credit have been outlined by researchers and observers of policy and practice (see Bailey & Karp, 2003; Boswell, 2001; Clark, 2001; Hoffman, 2005; Johnstone & Del Genio, 2001; Karp et al., 2007; Kim, 2006; Kirst & Venezia, 2001; Kruger, 2006). The major categories are as follows.

***Rigor and quality.*** One of the purported benefits of dual credit is its ability to increase student success and learning in high school in the following ways: by raising standards, by expanding course offerings, and by enhancing a student's prospects of gaining admission to college (see Boswell, 2001; Harnish & Lynch, 2005; Johnstone & Del Genio, 2001; McMannon, 2000). The higher expectations and level of rigor associated with college courses are thought to provide "more learning in high school"

(Johnstone & Del Genio, 2001, p. 26). For example, when Project Advance began in 1972 as the first dual credit program in the country, it was specifically designed to use dual credit to provide high school seniors with more rigorous academic options. Thus, the idea that college-level classes for high school students can and should be used to increase standards in high school is deeply rooted in the history and the logic of dual credit programs. Meanwhile, college-level courses are also used to expand high school course offerings by providing classes that are more advanced or by offering courses in subject areas that are not typically offered by high schools. This is particularly helpful in rural high schools (Boswell, 2001) that are either unable to hire enough teachers in high-needs areas or that cannot afford to offer certain advanced courses due to low enrollment.

Just as dual credit is thought to increase academic rigor in high school, it is also considered a mechanism for increasing student performance and success at the college level. Because it is perceived as rigorous and advanced, dual credit can increase a student's prospects of admission to college, particularly at elite institutions, which may view advanced coursework as a signal of academic achievement (Harnish & Lynch, 2005; Johnstone & Del Genio, 2001). Once students have matriculated to college, the benefits related to college success range from avoiding developmental courses to increasing opportunities for students to complete double majors, take more electives, and gain earlier entry into a major (Johnstone & Del Genio, 2001).

***Equity and access.*** The benefits of taking and passing introductory college courses while in high school differ based on the student's status, including whether the student is college-bound, first generation, and high-, middle- or low-achieving. For high-achieving students, dual credit provides opportunities for acceleration of coursework and degrees as described above. For students who are first-generation and middle- or low-achieving, dual credit is a tool for ensuring academic preparation for college (or college

readiness). For these students – who are not typically college-bound – there is an assumption that the transition from high school to college requires not only preparation for higher levels of academic rigor, but also an understanding of the attitudes, behaviors, and expectations of a college environment (Bailey & Karp, 2003). Therefore dual credit can be used to establish college-level expectations and teach the skills (such as managing time, registering for courses, reading a syllabus, and communicating with professors) required to navigate institutions of higher education. Researchers refer to these skills using phrases such as "college knowledge" (Conley, 2005) and "habits of mind" (Jobs for the Future, 2006). By providing opportunities for students to obtain these skills, dual credit can increase college enrollment and persistence for first-generation, low-income, minority, and middle- and low-achieving students (Bailey & Karp, 2003; Hoffman, 2005)

***Efficiency and effectiveness.*** Dual credit is assumed to save time and money in a number of ways that impact parents and students, high schools, colleges and even taxpayers. First, it has been argued that by raising academic rigor in high school, dual credit motivates and engages students and prepares them for college (Kruger, 2006; Hoffman, 2005). In addition to preventing dropouts, higher levels of student motivation and academic rigor can also contribute to degree production at the secondary and post-secondary levels. A second argument holds that students and their families can decrease the amount of time required to earn a degree by completing entry-level college requirements through dual credit and by avoiding enrollment in developmental education classes (Hoffman, 2005). By decreasing the amount of time that students spend in college, dual credit can save students money on tuition and student loans, thereby reducing their debt; in this way, dual credit is thought to lower costs.

Another efficiency and effectiveness argument in favor of dual credit is that it promotes institutional relationships between high schools and colleges. According to this

logic, by working together, secondary and postsecondary institutions can remove artificial barriers between K-12 and higher education, reduce duplication of efforts in courses and curricula, and contribute to a more seamless educational system (Boswell, 2001). Meanwhile, involving colleges in efforts to serve at-risk or low-achieving students, can improve the quality of resources or information available to students (Bailey & Karp, 2003). Finally, engaging high school teachers and college faculty in dual credit programs provides opportunities for collaboration and joint professional development (McMannon, 2000).

**Concerns about dual credit.** While many of the concerns about dual credit stem from the lack of research-based evidence about student outcomes, there are also questions about how programs are designed and implemented. A number of researchers have outlined the aspects of dual credit that cause concern (see Bailey & Karp, 2003; Boswell, 2001; Johnstone & Del Genio, 2001; Karp et al., 2003; Karp et al., 2005; Kim et al., 2003; Krueger, 2006; McMannon, 2000; Speroni, 2011a; Waits et al., 2005).

***Rigor and quality.*** Concerns about rigor and quality can be summarized through one overarching question: are dual credit courses actually taught at the college level (Kim et al., 2003)? Embedded within this question are a series of sub-questions about who should teach, what constitutes a true college experience, and how to decide the appropriate level of rigor for high school students enrolled in college courses. Attempts to define rigor and quality in dual credit are further complicated by the fact that dual credit can follow a number of different configurations. For example, dual credit can be taught by a full or adjunct professor; it can be offered on a high school or college campus and; courses can include all high school students or a combination of high school and college students. Some configurations may be considered more authentic, more rigorous,

or of higher quality by different stakeholders and, as a result, may impact perceptions about dual credit courses.

Who should teach? "The question of who is allowed to teach dual enrollment programs has implications for their perceived quality" (Karp et al., 2005, p. 1). Some states require dual credit to be taught only by postsecondary instructors while others allow dual credit to be taught by any postsecondary or secondary teacher (Karp et. al, 2003). In Texas, instructors must either be full-time faculty or meet the same standards as teaching faculty on the main campus (Texas Higher Education Coordinating Board, 2012c). In practice this means that dual credit courses are taught either by college faculty (full-time or adjunct) or by high school teachers who are hired as adjunct faculty. The Texas State Auditor (2010) identified monitoring and evaluation of dual credit teachers and courses as an area for improvement. The Texas Higher Education Coordinating Board (THECB) responded:

> In all cases, the [institution of higher education] bears the primary responsibility for the rigor and consistency of the college courses. However, [independent school districts] also play a role in ensuring the quality of dual credit programs … [school district] partners can help college faculty develop an understanding of the high school curriculum and graduation expectations, as well as the challenges that younger students may face in dual credit courses. It is important that the college faculty be sensitive to the needs and expectations of younger students" (2011, p. 22).

This example demonstrates that levels of rigor and quality are impacted by who teaches and what they understand about dual credit. It also highlights the challenges of monitoring dual credit partnerships which, by design, are a joint endeavor of secondary and postsecondary institutions. While administrators and teachers may recognize that the quality of teaching and learning is a joint responsibility, they may not necessarily agree on what constitutes a college experience.

What is a true college experience? It has been argued that dual credit cannot substitute for the experience of being on a college campus in a "true" college course. As it is currently implemented, dual credit courses can include some or all of the following design elements: located on a high school campus, taught by adjunct faculty, and comprised of all high school students. Depending upon one's perspective some, all, or none of these scenarios may be considered a true college experience. In a series of interviews with colleges, Johnstone & Del Genio (2001) identified a belief among some individuals that "college-level" describes not only course content, but also the university environment, including the independence and the inherent absence of structure compared to a high school setting. These differences in program design may be based on how resources are allocated by states and institutions or by the beliefs held by individuals who design and implement dual credit programs. Either way, one's definition of what constitutes a true college experience can have implications for the types of experiences and resources that a high school student may access through dual credit courses. While it will be discussed in greater detail in the section on student outcomes, it should be noted that researchers continue to compare the difference in student outcomes for courses taught on a college campus to those taught on a high school campus. One recent study (Speroni, 2011a) found no difference between outcomes for students who took dual credit on a high school campus and students who did not enroll in advanced coursework while in high school. Findings such as these and the debate over what constitutes a true college experience, in turn, raise the question of what level of rigor is appropriate for high school students.

How does one decide what is too little or too much rigor in dual credit? Some stakeholders believe the "college curriculum needs to be 'dumbed down' in order to be accessible to high school students" (Boswell, 2001, p. 13). However, some students have

reported that they do not feel challenged by dual credit courses (McMannon, 2000). This may explain why some stakeholders believe it is easier to earn a high grade in a dual credit course than a "regular" college course or an Advanced Placement course (Johnstone & Del Genio, 2001). Deliberation over the difference between "regular" and "advanced" coursework is pervasive in discussions about dual credit, and is related not only to the way in which a true college experience is defined, but also to levels of teaching and learning.

Based on the literature, it appears that program differences and one's definition of a true college experience impact levels of rigor and quality. There is generally limited state-level oversight of program content or type for dual credit, which allows institutions to determine what is most appropriate for students (Karp et al., 2005). While limited oversight provides institutions of higher education and school districts with wide latitude to implement dual credit programs, it leads to a lack of uniformity, which can create conflicting ideas about the appropriate levels of rigor, and may also fuel concerns about quality.

***Equity and access.*** In spite of the significant growth of dual credit, access to these programs is still limited. In fact, according to the National Center for Education Statistics, schools with the highest minority enrollment were the least likely to offer dual credit courses and schools in rural areas are less likely to offer dual credit (Waits et al., 2005). However, geography, which determines what type of institution a student can access (two-year, four-year, or none at all), can be the determining factor in whether a student can enroll in dual credit courses (McMannon, 2001). Finally, the majority of states restrict dual credit participation through admissions requirements which may include minima in any of the following areas: grade level, grade point average, or test scores (Bailey & Karp, 2003; Karp et al., 2005; Waits et al., 2005). While these

requirements help maintain rigor and quality, they may also have unintended consequences. The requirements may deter students who are qualified but unfamiliar with college-level requirements, thereby limiting access for students who could benefit from dual enrollment. Meanwhile, students who are academically prepared are likely to be successful in college, regardless of whether they enroll in dual credit; this raises a concern that dual credit may not be the most efficient use of limited state resources for students that are high-achieving. Thus, issues of equity and access are also linked to concerns about efficiency.

***Efficiency and effectiveness.*** Some studies have argued that dual credit does not shorten time to degree or save money, but results are mixed (Michelau, 2006). Some students choose to duplicate coursework to ensure that they earn higher grades (McMannon, 2000); while this ensures success in college, it does not decrease time to degree or result in cost savings. Whether or not coursework is duplicated usually depends more on the policies of four-year institutions than on student decision-making though (Boswell, 2001). As previously mentioned, Johnstone & Del Genio (2001) found that whether or not college-level credits earned in high school transfer and count toward college graduation depends on the selectivity of the higher education institution. Selective four-year institutions generally require students to earn scores of four or five on AP exams and may discourage or disallow transfer of dual credit. By comparison, less selective institutions are more likely to award college credit for lower AP scores and to allow dual credit courses to transfer.

State policies that allow both school districts and colleges to receive funding for dual credit students have also generated efficiency concerns. There are two clearly defined points of view on this issue; what some refer to as "double-dipping" (Boswell, 2001), others refer to as "hold-harmless funding" (Hoffman, 2005). Both terms – "double

dipping" and "hold-harmless funding" – refer to a practice in which states simultaneously provide funds both to a college and to a school district when a student is enrolled in a dual credit course. While both of these terms refer to the same funding practice, they serve different rhetorical purposes. "Double dipping" is meant to imply that one of the institutions (either the college or the school district should) not receive funding when a student enrolls in a dual credit course. By comparison, the phrase "hold harmless funding" is used to embody the idea that both the college and the school district should receive funding when a student enrolls in a dual credit course. According to this logic, both partners have an incentive and the resources to extend full support to dual credit students. In addition to conveying opposite meanings, the terms "hold harmless" and "double dipping" represent very different perspectives about whether dual credit is considered to be an efficient investment.

As enrollment in dual credit has grown, so too has the expectation that these courses will provide academic rigor and increase efficiency and effectiveness, particularly for underserved students. Implicit in this expectation is the assumption that dual credit courses prepare students for coursework at a four-year institution. The benefits of dual credit, which are based on the premise that dual credit prepares students for college, emphasize how it will help students graduate from high school and college, thereby saving time and money. For students who are at risk of not graduating from high school or college, dual credit is considered an even greater return on investment if it helps them graduate from college. However, a number of stakeholders have raised concerns about whether the benefits of dual credit are being fully realized, not only in terms of the efficiency of the program, but also in terms of the rigor, quality, and equality of access for underserved students (see Bailey & Karp, 2003; Boswell, 2001; Johnstone & Del Genio, 2001; Karp et al., 2003; Karp et al., 2005; Kim et al., 2003; Krueger, 2006;

McMannon, 2000; Speroni, 2011a; Waits et al., 2005). The benefits of and concerns about dual credit are deeply intertwined with beliefs about what type of students the program should serve and how they should be served.

### DATA LIMITATIONS

The best way to clarify whether the benefits and concerns related to dual credit are of great significance is to conduct research on the topic. However, research on dual credit was – and in many cases still is – limited by the availability of data at the local, state, and national levels. Collecting data and analyzing outcomes for dual credit courses requires coordination among many different organizations including high schools, school districts, colleges, and states; but many organizations either do not collect dual credit data or do not do so systematically (Hoffman, et al., 2009; Karp, Calcagano, Hughes, Jeong, & Bailey, 2007; Karp & Jeong, 2008; Venezia, Finney, & Callan, 2007). Ideally, states would develop data systems that would link secondary and postsecondary data and allow researchers to statistically control for students' background characteristics and prior academic achievement (Bragg, 2006; Bragg et al., 2005; Karp & Jeong, 2008; Lerner & Brand, 2006). However, tracking students across multiple education systems and into the workforce can be difficult or impossible. Many states simply do not have databases that link secondary and postsecondary performance and outcomes (Karp & Jeong, 2008; Lerner & Brand, 2006). States that have databases do not necessarily include the "elements essential for dual [credit] research" such as an indication that a course is dual credit (known as a dual credit flag), the location where courses are taught (high school or college campus), or the instructor type (high school teacher or college professor) (Karp & Jeong, 2008, pg. 4). To address the lack of knowledge about how to conduct dual credit research, the U.S. Department of Education published a report designed to provide a

framework for collecting the information needed to effectively evaluate dual credit (Karp & Jeong, 2008). The national studies released by the National Center for Education Statistics in 2013 (Thomas, Marken, Gray & Lewis, 2013; Marken, Gray & Lewis, 2013) reflect these recommendations. And, while following the guidance of this report will certainly provide much more useful data at the both at the national and state level, it would not necessarily mitigate all data issues.

Even when data are collected at the state level, it is difficult to make comparisons between states. Michelau (2006) identifies two reasons that state-level comparisons of dual credit can be problematic: (1) the way that dual credit is implemented both within and between states varies widely and (2) data collection efforts are neither universal nor uniform across the country. Bragg (2006) expands on the complications of dual credit data collection, pointing out that national dual credit data yield information on macro-trends in enrollment and impact, which are not particularly useful at the institutional level. Instead, emphasis should be placed on research at the institutional level – and particularly on outcomes for specific student populations – because this is where dual credit programs are implemented.

A study of dual credit data in Texas (Eklund, 2009) found that "[w]hile Texas has excellent data collection systems and the capacity to track students from high school to college, the dual credit data available in the systems is limited and not well-aligned" (p. 243). This study identified several notable inconsistencies in data collection at the state level. For example, the number of students who were enrolled in dual credit courses that were reported in either the state's higher education data system or the K-12 data system, but not both, was rather high. Twenty-nine percent of dual credit students reported by higher education institutions were not found in the K-12 data system and 26% of students reported to the Texas Education Agency could not be identified in the higher education

data system. Other inconsistencies that were found in data reporting and collection include concurrent enrollment and Advanced Placement courses reported as dual enrollment.

A study by Rodriguez, Hughes, and Belfield (2012) that examined the outcomes of career-focused dual credit programs at eight schools in California demonstrates how variations in dual credit programs can complicate data collection efforts within states. The researchers identified a "complex pattern of [dual credit] program implementation" that varied widely across sites (p. 9). While the intent of the program was to maintain consistent goals from year to year across the different sites, the researchers found variations in how the program was implemented across sites and years. In order to account for the variety of program implementation, the researchers analyzed their data in three ways: by individual site, by year of implementation, and by all sites and years combined (or pooled). In addition to demonstrating the wide degree of ways that dual credit courses can be implemented within a state or a school district, this example also reinforces Bragg's argument that research at the institutional level should be emphasized because it has potential to yield the most information and impact. Whether the focus is national, state, or institutional, researchers agree that additional examination of dual credit is necessary (Bragg, 2006; Hoffman et al., 2009; Karp & Jeong, 2008; McMannon, 2000; Michelau, 2006).

It is important to acknowledge that dual credit students may have unique and/or unobserved characteristics prior to enrolling in dual credit that impact their student outcomes. For example, many states and education institutions require students to earn minimum test scores or grade point averages to enroll in dual credit. Meanwhile, when compared to their peers who do not take dual credit, those students who choose to enroll in college courses while in high school could have higher levels of motivation, greater

exposure to academic support, or more academically rigorous schooling backgrounds (Bragg, 2006; Kim, 2006; Speroni 2011a, 2011b). While randomized research designs are the ideal because they control for a student's pre-existing characteristics, this type of research design is often impractical or impossible. Therefore, when conducting quantitative research on dual credit it is important to use rigorous statistical methods that control for unobserved characteristics (Bragg, 2006; Bragg et al., 2005; Karp et al., 2007; Karp & Jeong, 2008, Kim, 2006).

## QUANTITATIVE DUAL CREDIT RESEARCH

Historically, there has been a dearth of quantitative studies that examine dual credit outcomes while statistically controlling for student characteristics (Bragg & Kim, 2005; Karp et al, 2007; Karp & Jeong, 2008; Kim, 2005). However, in recent years dual credit has emerged in all 50 states (Bragg, Kim, & Rubin, 2005) and state data systems have begun to link secondary and postsecondary performance and outcomes. As a result, the amount of empirical literature has expanded and more researchers have conducted studies examining student outcomes. Kim and Bragg (2008) point out that even though the body of quantitative research on dual credit has grown, a number of early studies failed to apply statistical controls that allow for dual credit effects to be examined independent of student background characteristics (these include Black, 1997; Crook, 1990; Gurule, 1996; Monroe Community College, 2003; Richardson, 1999; Spurling & Gabriner, 2002; Windham, 1996). Thus, while many studies have found positive effects of dual credit, many are methodologically flawed.

**Summaries of quantitative dual credit studies.** This section of the paper examines eight studies that apply statistical controls (these include An, 2013; Eimers & Mullen, 2003; Karp et al., 2007; Kim, 2006; Nitzke, 2002, Radunzel, Noble, & Wheeler,

2012; Speroni 2011a, 2011b; Struhl and Vargas 2012; Swanson, 2008). Two additional studies (Delicath, 1999; Kotamraju, 2005) are included because they provide insights that are useful for conducting studies which apply controls. Each study is presented in chronological order and described briefly.

Delicath (1999) studied 2,760 students at Saint Louis University who took dual credit and Advanced Placement prior to entering the institution. Based on persistence and retention theories, the study employed logistic regression to compare the following outcomes for students with and without college credit: first-year persistence, six-year graduation, time to graduation. Although the initial analysis did not account for possible differences in student achievement prior to entering college, this study is included for three reasons. First, the researcher conducted supplemental analysis that accounts for prior student achievement by using ACT as a control statistic. Second, the commentary and new outcomes that accompany the supplemental analysis are illustrative for understanding the importance of controlling for student background characteristics. Finally, it is one of only two empirical, peer-reviewed, quantitative studies available in ERIC when the terms “dual credit” or “dual enrollment” and “persistence” or “retention” are searched. While the supplemental analysis addresses some concerns about controlling for student achievement, the model does not consider that there may be differences between students who take dual credit, AP, or a combination of both.

Nitzke (2002) wrote a dissertation that examined a school-based dual credit program implemented through a Midwestern community college. Using a conceptual framework based on “seamless education systems” (or P-16 partnerships) and longitudinal time design (1993-2001) the study followed 568 dual credit students over eight years from the time they enrolled in dual credit until they completed college. Using stratified random sampling, Nitzke selected a control group of 1,007 traditionally-

enrolled students. The study employed logistic regression to examine degree completion and time to degree.

Eimers and Mullen (2003) studied 7,913 first-time, full time students at the University of Missouri who attended college within one year of high school graduation. Using linear and logistic regression to control for academic ability, Eimers and Mullen examine the effect of dual credit on first-year grade point average and retention for four different groups of students: no college credit, dual-credit only, AP-only, and a combination of AP and dual credit. No theoretical framework is cited in this paper.

Kotamraju (2005): In 1985, Minnesota became the first state to legislatively codify a dual enrollment program, the Postsecondary Enrollment Option (PSEO). Using data from the Minnesota State Colleges and Universities System, Kotamraju's sample consisted of 461 students who had PSEO experience between Fall 1999 and Spring 2001, entered the two-year institutions within the Minnesota System in Fall 2001, and moved towards attaining a credential anytime during Fall 2001 and Spring 2004. The study used a control group that included students who did not have the PSEO experience but were similar to the PSEO students in all other ways. Methods of analysis include: Analysis of Variance and Chi Square tests to examine whether career and technical education (CTE) dual enrollment impacts college GPA and degree attainment. No theoretical framework is explicitly cited in this unpublished paper. However, it examines technical dual credit from the perspective of college readiness.

Kim (2006) wrote a dissertation using Astin's Input-Environment-Outcome (IEO) model to examine the impact of dual and articulated credit on college readiness and total college-level credit hours for a sample of 1,141 high school graduations in four state consortia: Florida, Ohio, Oregon, and Texas. The researcher employed multiple and

logistic regression analyses to produce results. This study is important because it identified a number of previous studies that lacked statistical rigor.

Karp et al. (2007) examined the impact of dual credit on career and technical education (CTE) students in Florida and New York. The Florida dataset included 299,865 students in the 2000-01 and 2001-02 senior cohorts. The New York dataset included 2,303 who attended one of 19 vocational high schools in New York City and enrolled in the City University of New York after graduation. With datasets that included high school and college outcomes, this study used ordinary least squares and logistic regressions to control for students characteristics and examine the following outcomes: high school graduation and college enrollment, GPA, credit accumulation, and persistence.

Swanson (2008) was the first researcher to use national data to examine the impact of high school students' participation in dual enrollment courses on college persistence and degree attainment. Using restricted data sets and variables constructed from the National Education Longitudinal Survey (NELS: 88/2000) and the Post-secondary Education Transcript Study (PETS: 2000), Swanson examined outcomes for dual credit students who graduated from high school in 1992 and entered post-secondary education.

Speroni (2011b) uses regression discontinuity analysis to examine the effects of taking at least one dual enrollment course and the effects of taking dual enrollment college algebra. This study of 229,904 public school students in Florida in the 2000-01 and 2001-02 senior cohorts takes advantage of the fact that students in Florida must meet two requirements: (1) to enroll in any dual credit course, students must have a minimum GPA of 3.0 and (2) to enroll in a dual credit algebra course, students must earn a minimum standardized test score. Regression discontinuity analysis estimates the impact

of dual credit by comparing the outcomes of students above and below the GPA or standardized test cutoff score. Speroni's study is unique for three reasons: it is the first dual credit study to use a quasi-experimental design, it examines students who went to college as well as those who did not, and it identifies the location (high school or college campus) and type of dual credit course (academic or technical).

Speroni (2011a) used administrative records for all 229,828 students in the 2000-01 and 2001-02 senior cohorts in Florida to extend a previous study which employed regression discontinuity analysis. The study investigates the following questions: 1) Is there an association between AP and dual enrollment course taking and a student's likelihood of enrolling in college, first enrolling in a four-year (rather than two-year) college, and earning a bachelor's degree and; 2) Do these effects depend on students' minority status and academic ability?

Struhl and Vargas (2012) use data from Texas and employ logistic regression and a propensity score matching model to control for student background characteristics. The study examined the relationship between dual credit and three outcomes: college enrollment, persistence from first- to second-year of college, and degree completion.

Radunzel, Noble, and Wheeler (2012) conducted research on behalf of ACT using data from four Texas colleges including: The University of Texas at Austin, Texas A&M University at College Station, Texas A&M University at Commerce, and University of Texas-Pan American. Using propensity score matching, the study examined retention, GPA, bachelor's degree completion, credit hour accrual, and grades in first year college courses.

An (2013) conducted a peer-reviewed study using propensity score matching to examine a national dataset, the National Longitudinal Study of 1988. The study examined

degree completion with a specific focus on the effects of dual credit for low-income students.

**Outcomes of quantitative dual credit studies.** The section synthesizes the outcomes that have been examined across the body of dual credit research including: college enrollment, grade point average, college credit accrual and developmental courses, persistence, degree attainment, time to degree, and type and source of dual credit.

***College enrollment.*** In one study (Struhl & Vargas, 2012), completion of one dual credit course caused students to be up to 2.30 times more likely to enroll in any type of college than a student who did not take dual credit. According to three other studies, dual credit has an effect on specific aspects of college enrollment (Karp et al., 2007; Speroni, 2011b; Swanson, 2008). In one study (Karp et al., 2007), dual credit students had a higher likelihood of enrolling in college full-time, while in another (Swanson, 2008), they were 12% more likely to enter college within seven months of high school graduation than non-participating students. According to Speroni (2011b), taking at least one dual credit course had no significant impact on either high school graduation or college enrollment, unless it was dual credit algebra. Those students who took dual credit algebra were more likely to enroll in college, but only at a two-year institution. Based on these studies, dual credit can positively influence college enrollment, but the subject area and rigor of dual credit courses may be an important consideration.

***Grade point average.*** GPA is a frequently-observed indicator of academic performance that is tested in three studies. One study (Eimers & Mullen, 2003) did not find that dual credit students had higher GPAs, unless they took a combination of dual credit and AP courses. Two other studies (Karp et al., 2007; Kotamraju, 2005) found that dual credit positively influenced college GPA, but the effects did not extend beyond the

second year of college. Eimers and Mullen (2003) developed a model that was statistically significant and explained approximately 29% of the variance in first-year college GPA. However, holding ability indicators constant, they found that dual credit students performed neither better nor worse in college than non-dual credit students. Instead, students who entered with AP only or a combination of AP and dual credit had the highest predicted GPAs. Predicted freshman GPAs were as follows: 3.18 for AP only; 3.14 for AP and dual credit and; 2.97 for either dual credit or students with no previous college credit. Thus, a combination of dual credit and AP enhanced college GPA, while dual credit alone had no effect.

Karp et al. (2007) examined the short- and long-term impact of dual credit on GPA for cohorts of students in New York and Florida. One year after high school graduation, dual credit students in both states had higher GPAs than their non-dual credit counterparts. Three years after high school graduation, dual credit participants in Florida earned higher GPAs than non-participants. Meanwhile, in New York, four semesters after high school graduation, there was not a significant difference between the GPAs of dual credit participants and non-participants. Karp's finding in New York, that the effects of dual credit decrease over time, mirror Kotamraju's (2005) findings.

***College credit accrual and developmental courses.*** Karp et al. (2007) found that dual credit students in Florida and New York earned more credits than their non-dual credit counterparts, with participants in Florida earning 15.1 more credits and participants in New York earning 10.6 more credits than non-participants. Speroni, (2011a) found that in addition to earning more credits and doing so faster, dual credit students also require less remediation.

***Persistence.*** Four studies examined various persistence milestones – including

the second semester of college, the second year of college, and senior year – and found that dual credit students have higher levels of retention than their non-dual credit peers. Struhl and Vargas (2012) found that students in Texas who complete at least one dual credit course were between 1.79 and 2.00 times more likely to persist from first to second year, depending on the combination of dual credit and high school coursework taken. Eimers and Mullen, (2003) found that, holding student ability constant, two groups of students were statistically significantly more likely to persist from freshman to sophomore year in college – those who entered college with a combination of AP and dual credit or AP only. Students with an AP and dual credit experience had the highest probability of persisting (83.6%), followed by those with AP credit only (56.6%). An earlier study by Delicath (1999) found that dual credit positively influenced time to degree. However, unlike Eimers and Mullen, Delicath did not consider dual credit and AP separately in the analysis.

Swanson (2008) found that dual credit influenced persistence in specific ways. Dual credit students were more likely (11%) to continue through the second year of college than non-participating students. However, dual credit students who completed 20 or more credits in the first year of college had an even greater likelihood of persisting (28%). Thus, dual credit increased retention rates from 11% to 28%, depending upon the number of courses a student completed in their first year of college. Based on these findings, Swanson asserts that dual credit may create a "nest egg" effect which encourages students to stay in college and subsequently creates positive postsecondary outcomes.

***Degree attainment.*** When considering the impact of dual credit on degree attainment, researchers have examined many questions including: the influence of dual credit on earning a high school diploma; the likelihood of earning an associate's versus a

bachelor's degree; the probability that dual credit students will earn a graduate degree and; how long it will take for students to earn these degrees. In some cases, dual credit positively impacted degree attainment, and in others it had little or no effect, but the outcomes varied greatly depending on the particular combinations of questions that researchers considered.

Karp et al. (2007) examined high school degree attainment and found that dual credit was positively related to students' likelihood of earning a high school diploma in Florida. Four studies considered how dual credit impacts the likelihood of receiving a college degree, but results were mixed. The four more recent studies (Delicath, 2009; Radunzel, Noble & Wheeler, 2014; Speroni, 2011a; Struhl & Vargas, 2012) found positive relationships between dual credit and degree attainment, while the two earlier studies (Nitzke, 2002; Swanson, 2008) did not.

Two studies found positive effects for students who took at least one dual credit course. Struhl and Vargas (2012) found that students in Texas who completed at least one dual credit course were 1.66 to 1.77 times more likely to obtain either an Associate's or a bachelor's degree within six years than students who did not participate in dual credit. These results were similar to those of Speroni (2011b) which found that the type of dual credit course a student takes affects the likelihood of earning a degree. Students in Florida who took at least one dual credit course (other than algebra) were not significantly more likely to earn an associate degree, but students who took dual credit algebra were more likely to earn either an associate's or a bachelor's degree. Meanwhile, Delicath (2009) found that dual credit students were more likely to obtain a degree. However, this study categorized dual credit and AP students together, so it is possible that results would be different if the groups were examined separately.

Radunzel, Noble, and Wheeler examined the differences in graduation for students at different levels of dual credit course taking. They found that students with more than 12 hours of dual credit were more likely to complete a bachelor's degree than students who earned fewer than 12 hours of dual credit. Meanwhile, An (2013) studied whether the effects of dual credit differed based on levels of family income and found that students who took dual credit were more likely to complete a bachelor's degree than non-dual students. However, the significant, positive effects were greater for low-income students than their peers from more affluent backgrounds.

Nitzke (2002) found that dual credit students were not more likely to earn college degrees than non-participants. Swanson (2008) found that, without taking into account any other factors, dual credit actually reduced the likelihood of earning a bachelor's degree by 10%. However, dual credit students who entered college within seven months of graduation improved their chances of earning a bachelor's degree by 12%. And compared to non-participants, dual credit students who earned at least 20 credits in their freshman year increased their chances of earning a graduate degree by 14% and taking graduate-level courses by 34%.

***Time to degree.*** Two studies examined time to degree. Delicath (1999) – who did not initially control for student achievement – conducted supplemental analysis and found that dual credit had no effect on time to degree. Meanwhile, Swanson (2008) found a positive effect, but only under specific conditions. Based on the average time to degree of 4.56 calendar years observed by Adelman in 2004, Swanson considered the likelihood of earning a degree in more or less than the average. Dual credit students were not statistically more likely to complete their degrees in less than 4.56 years. However, those dual credit students who built academic momentum by earning at least 20 credit hours by the end of freshman year increased their likelihood of earning a degree in the

average amount of time by 38%. Meanwhile, those students who persisted through their second year without more than a one semester break increased their likelihood of earning a degree in less than 4.56 years by 41%. Thus, dual credit did positively influence time to degree if students earned at least 20 credit hours in their first year and did not take time off from school for more than one semester.

***Type and source of dual credit.*** Two related questions that are often considered together are the type and source of dual credit. When studying the type of dual credit, researchers examine and compare academic versus technical dual credit (Kim, 2006; Kim and Bragg, 2008). Studies examining source of dual credit will compare courses taught at a high school to those on a college campus (Speroni, 2011a), or dual courses offered by a two-year versus a four-year institution (Eimers & Mullen, 2003). It should be noted that while there is significant interest in questions about the source of dual credit (particularly the question of high school versus college campus), very few datasets include this level of detail due to the complexity of gathering the data.

Kim and Bragg (2008) found significant relationships between academic dual credit and college readiness in mathematics, reading, and writing. The study also reported a significant negative relationship between academic dual credit hours and total college credit hours in Texas; Kim and Bragg reasoned that students enrolled in academic dual credit may be oriented toward four-year rather than two-year institutions.

Eimers and Mullen (2003) considered whether the source of dual credit impacted a student's GPA. To explore this question, they divided dual credit into four categories based on the type of institution: within the Missouri system at Campus A or Campus B; at other four-year institutions and; at two-year institutions in the state. While the model was statistically significant, they found that the type of institution from which credit was earned did not contribute to GPA; instead, ACT composite score and percentile rank were

contributing factors. Speroni's (2011a) study of AP and dual credit considered the impact of taking dual credit at a high school versus a college campus and concluded that there was no effect for courses taken on the high school campus. This conclusion was drawn based on the finding that there is no difference in performance between students who take dual enrollment exclusively at a high school campus and students who do not take either AP or dual enrollment.

Questions about source of dual credit may be a proxy for questions about rigor and quality. However, there is not enough empirical evidence to determine whether it is preferable for dual credit to be taught on a high school or college campus or by certain types of teachers (full-time college faculty as opposed to adjunct professors or high school teachers). And, as previously noted, most dual credit data collection either cannot or does not occur at this level of detail.

***Intensity of dual credit course-taking.*** This refers to either the number of dual credit courses that a student takes or the combination of dual credit and other college preparation programs, such as Advanced Placement. Two studies (Eimers and Mullen, 2003; Speroni, 2011a) compared dual credit to AP students and found very little difference. According to Speroni (2011a), there was no difference in degree attainment between the two groups. Meanwhile, Eimers and Mullen (2003) found that students with dual credit only (as opposed to a combination of dual credit and AP) had higher percentile ranks and ACT scores than students who did not participate, but they did not perform at significantly higher levels than students who had participated in other pre-college programs such as AP.

Karp et al. (2007) found that among students in New York dual credit outcomes were impacted by the intensity of course-taking in the following ways: participating in two or more dual credit courses increased the likelihood of full-time college enrollment,

earning a higher GPA, and accruing more credits. Interestingly though, these students did not maintain higher GPAs over time. Thus, Karp et al. (2007) found that the effects and intensity of dual credit diminished over time with regard to college GPAs.

Two other studies (Kotamraju, 2005; Nitzke, 2002) also found that the effect of dual credit on GPA decreased over time. Nitzke (2002) concluded that the "jump start" function of dual credit varies by award type, accelerating completion for students earning a high school diploma, but having no significant effect for degree-seekers. Bragg (2006) points out that in Nizke's study, dual credit students attempted and completed fewer courses than non-dual credit students and speculates that this may be related to the fact that dual credit students tend to transfer to four-year universities at higher rates than other community college students.

Based on these studies, dual credit is thought to positively influence college readiness, college enrollment, GPA, credit hour accrual, and retention. In some cases, it positively affected degree attainment and time to degree, while in others cases, results were mixed. Based on one study, the location where dual credit is taught (high school versus college campus) may be an important consideration. Based on another study, the type of institution teaching dual credit (two-year versus four-year college) did not seem to matter. Meanwhile, taking dual credit and AP courses may produce additional positive effects for students. Similarly, taking a certain number of courses (two or more) or type of courses (dual credit algebra) led to higher levels of success for students. In summary, dual credit courses taught at the appropriate level of rigor appear to positively influence student outcomes, at least to some degree.

Part one of this review of literature considered the concept of student success and examined theories of persistence. The second and third sections of the chapter investigated dual credit literature and outlined the dual credit outcomes that have been

examined to date through empirical research. This final section examines the theoretical frameworks that will be employed in this study.

# Theoretical Frameworks

This study will employ two separate, but related, theoretical frameworks to examine college outcomes of dual credit students: Human Capital Theory (Becker, 1975) and Academic Capital Formation (St. John, Hu, & Fisher, 2011). Human Capital Theory emphasizes the relationship between education and future earnings and acknowledges that individuals invest in education based on the level of expected financial return. Academic Capital Formation, which is based on Human Capital Theory, focuses on the knowledge, programs, and interventions (or academic capital) that allow underrepresented students to access college.

## HUMAN CAPITAL THEORY

Becker's (1975) Human Capital Theory defines expenditures on education as an investment in human capital which enables individuals to increase their lifetime earnings. While Becker originally intended to use economic principles to estimate the rate of financial return to high school and college education, what emerged from his study was a formal acknowledgment and analysis of "the effect of the productive process itself on worker productivity" (Becker, 1993). Thus, rather than focusing on the production of physical or financial capital produced by firms, this framework emphasizes the knowledge and skills (or human capital) that individuals accumulate through education and experience.

Human capital is similar to other forms of capital, but it has several important distinguishing characteristics. Like physical and financial capital, it is acquired.

However, human capital is accumulated by individuals through education and experience rather than by purchasing, selling, or trading. Because workers cannot be separated from their knowledge and skills, human capital accumulates to individuals and cannot be taken away. Therefore, human capital differs from other forms of capital because it is both intangible and portable. As such, because education allows individuals to build knowledge and skills, it is viewed as an investment in human capital.

One of the fundamental tenets of economics that is incorporated into human capital theory is that "the amount invested is a function of the rate of return expected" (Becker, 1993, p. 100). Therefore, individuals who expect higher levels of return will invest more in their human capital. Becker describes the relationship between human capital accumulation and earnings as follows: "[h]uman capital analysis assumes that schooling raises earnings and productivity mainly by providing knowledge, skills, and a way of analyzing problems" (Becker, p. 19). This is reinforced by a U.S. Census Bureau study which found that average lifetime earnings increase with educational attainment, and educational payoffs occur most frequently at the highest educational levels (Day & Newberger, July 2002). Based on this premise, students are encouraged to earn a college degree in order to increase their lifetime earnings and dual credit serves as a mechanism that allows students to begin earning college credits while still in high school. However, Human Capital Theory also presumes that "there are optimal combinations of inputs over an optimal investment period that maximizes the present value of benefits" (Becker, 1993, p. 114). By enabling students to accumulate college credits – for free or at a reduced cost – while still in high school, dual credit provides a mechanism through which individuals can optimize their investment in human capital in order to maximize the benefits they receive.

There are three assumptions about an individual's demand for human capital that Becker (1975) outlines. First, because our lifetimes are finite, investments made early in life produce benefits for a longer period of time than investments made later in life. Second, investments made later in life have less present value than investments made earlier in life because the benefits are postponed. Finally, while the value of an individual's time is small (and possibly negative) when they are young, as an individual ages and human capital is accumulated, their time becomes more valuable. Therefore, investments in human capital cost less when made early in life rather than later in life. These assumptions about demand for human capital can be applied to dual credit, which enables individuals to maximize their human capital accumulation while they are young while also minimizing the amount of time and money they invest.

One aspect of dual credit that is particularly important to consider when conducting research on the topic is that dual credit students may have unique or unobserved characteristics that are difficult to measure (see Bragg et al., 2005; Bragg, 2006; Karp et al, 2007; Karp & Jeong, 2008; Kim, 2006; Speroni 2011a, 2011b). According to Becker, individuals with greater ability tend to invest more in human capital and, as a result, there is a strong correlation between ability and investment in human capital (Becker, 1975). While this observation does not mitigate the research and statistical analysis concerns associated with unobserved characteristics, it does formally acknowledge that students who enroll in dual credit may have different traits than their peers. Considering that a number of previous studies did not consider or account for potential differences between students who take dual credit and those who do not, it is important and useful that this is included in Human Capital Theory.

Despite its applicability to this study, Human Capital Theory has also been criticized for focusing on people as a mode of production and for failing to recognize that

upward mobility is limited by a class structure that is inherent to society and education (Bowles & Gintis, 1972; Collins, 1971). In recognition of these limitations, this study will employ a second theoretical framework which presents a model for how underrepresented students mitigate and address the limitations to upward mobility that are presented by the class structure.

### ACADEMIC CAPITAL FORMATION

St. John, Hu, & Fisher (2011), developed this critical-empirical framework based on successful reform programs and social and human capital theory (see Becker, 1964, 1975, 1993; Bourdieu, 1990; Coleman, 1988). This theory posits that underrepresented students and their families navigate educational systems by acquiring and using specific types of knowledge and skills (or academic capital). As such, the theory focuses on how information, resources, and communication impact an individual's actions. It was designed to inform and revise public policy and to "provide a foundation for a new generation of research on interventions that aim to improve educational opportunity for underrepresented students" (p. 48). Dual credit, which is used to enable underrepresented students to gain exposure to and experience in college-level courses, is the type of intervention to which Academic Capital Formation is referring. Therefore, Academic Capital Formation serves as a complementary framework to Human Capital theory for examining the college-level outcomes of dual credit students.

Academic capital is defined as: "social processes that build family knowledge of educational and career options and support navigation through educational systems and professional organizations" (St. John et al., 2011, p. 1). Academic capital is formed through a variety of activities, including: reading to young children, adults communicating an expectation that students will attend college, and students taking

advanced courses in high school to (St. John et al., 2011). While academic capital acquisition "has been beyond the reach of most families that do not have college knowledge or the resources to pay for college," according to St. John et al., academic capital can be developed through social, educational, and financial interventions (2011, p. 1). Therefore, the process of forming academic capital can be either promoted or inhibited by the beliefs and practices of students, families, or schools.

St. John et al. examined academic capital formation across a variety of programs in five major areas: 1.) family and community engagement, 2.) academic preparation, 3.) college choice, 4.) engaged learning, and 5.) academic success. The second major area, academic preparation, includes access to advanced courses, or dual credit. St. John et al. describe the role of dual credit in academic capital formation as follows: "when viewed as a social process, gaining access to advanced high school courses takes on different dimensions than merely being predictive of eventual college success, although the evidence here and elsewhere confirms that correlation" (2011, p. 206). Therefore, access to advanced courses not only facilitates academic achievement, but also develops social navigation skills and college knowledge.

Two patterns of behavior were identified as underpinnings of academic capital formation – college knowledge and family uplift (St. John et al., 2011). College knowledge includes three components: envisioning one's self and family as college students, understanding the role college courses have in preparing for graduate education and the workforce, and using one's resources to identify and pursue appropriate pathways through educational systems. Meanwhile, family uplift is a pattern of behavior within families and social networks that support the development of the following: college knowledge, the ability to navigate education and employment systems, and expansion of educational opportunity across generations. St. John et al. found that students who are

engaged in developing academic capital exhibit both college knowledge and family uplift.

St. John et al. (2011) assert that students and parents may develop college knowledge and engage in family uplift as a response to financial circumstances. In other words, individuals may obtain a college education in order to overcome economic challenges. This assertion draws a connection between the two theories – Human Capital and Academic Capital Formation – and demonstrates how the work of St. John et al. complements Becker's earlier concepts.

Both theories consider how purposeful participation in education impacts an individual's economic circumstances. From the Human Capital perspective, individuals acquire education and experience because they expect to increase their earnings. However, as previously discussed, one of the major critiques of this theory is its lack of acknowledgment of class structure and its failure to consider workers as more than a means of production. Academic Capital Formation asserts that for underrepresented students and their families, the motivation for increasing one's earnings is the prospect of family uplift. But, increasing one's earnings requires underrepresented families to acquire and use a specific knowledge and skills to navigate educational systems. By developing college knowledge, underrepresented students are able to overcome the many barriers (including class barriers) they encounter in the educational system.

The combination of theories developed by Becker and St. John et al. are useful for this examination of dual credit outcomes in Texas. Taken alone, Human Capital Theory would posit that all students enroll in dual credit courses in order to decrease time to degree and enter the workforce quickly in order to maximize their degrees in the workforce. It is quite possible that this is the case, but by using Academic Capital Formation, one may also consider whether dual credit courses have a unique or different

impact on the outcomes of students who are historically underrepresented in higher education.

## Conclusion

This review of literature began with a brief examination of the concept of student success, with a specific focus on student persistence. The next two sections of the chapter thoroughly considered dual credit, including its history, the benefits and concerns, and the current state of research on dual credit. The final section of the chapter detailed the two theoretical frameworks that will be employed in this study. The review of literature accomplishes three objectives. First, it explains how and why dual credit is thought to promote academic success in college. Second, it demonstrates the need for additional dual credit research. Finally, it provides context for the measures of student success (grade point average and degree completion) and the theoretical frameworks (Human Capital and Academic Capital Formation) that will be employed in this study.

# CHAPTER 3: METHODS

## Overview

Between 2003 and 2010, the number of high schools offering dual credit in the United States increased from 71% to 82% and enrollment grew from 1.2 million to 2 million students (Thomas, Marken, Gray & Lewis, 2013; Waits, Setzer, & Lewis, 2005). In spite of this significant growth, there is limited research on dual credit. This study, which focused on the educational outcomes of dual credit students who attend public institutions of higher education in Texas, specifically examines the relationship between dual credit course-taking and college GPA and graduation. This chapter describes the research design for the study, including: the research questions, a description of the data, and the methods of analysis.

## Research Design

### RESEARCH QUESTIONS

This study was guided by the following research questions and hypotheses:

1. Are there differences in dual credit enrollment for students who are underrepresented in higher education?

   *Hypothesis: Underrepresented students have lower enrollment in dual credit than their peers.*

2. What is the relationship between dual credit and academic preparation, as measured by grade point average after the first semester of college?

   *Hypothesis: Dual credit students have higher grade point averages than non-dual credit students after the first semester of college.*

3. How does dual credit influence the probability of college graduation?

*Hypothesis: Dual credit students are more likely to complete their bachelor's degrees than non-dual credit students.*

According to a review of the literature summarized in Chapter 2, in order to understand the relationship between dual credit and student success in higher education, it is necessary to statistically control for students' background characteristics and prior academic achievement (Bragg, 2006; Bragg et al., 2005; Karp & Jeong, 2008; Lerner & Brand, 2006). Therefore, this study employed a quantitative research design.

## RESEARCH MODEL

The variable of interest for this quantitative study was dual credit. The control variables for the study (which are detailed in Chapter 2 and summarized below) were organized into two categories, academic and demographic. All of the variables were selected based on the literature review as well as available data from the Texas Higher Education Coordinating Board. The study was guided by two theoretical frameworks: Human Capital Theory (Becker, 1993) and Academic Capital Formation (St. John et al., 2011). Together, these theories provide a lens to examine whether and how dual credit may enable high school students, including those who are underrepresented in higher education, to develop skills to succeed in college.

Based on the literature, theories, and available data there were two causal models in this study, one for Ordinary Least Squares (OLS) regression and one for binary logistic regression. In both models, dual credit was coded as a continuous variable (from 0 to 98 hours), based on the total number of hours of dual credit each student transferred into college. The OLS regression model for GPA (a continuous variable) and the logistic regression model for graduation (a dichotomous variable) are detailed as follows:

Figure 3.1 GPA Research Model

$\hat{Y}(GPA) = a + b_1*(\text{dual credit}) + b_2*(\text{race/ethnicity}) + b_3*(\text{gender}) + b_4*(\text{parental education}) + b_5*(\text{family income}) + b_6*(\text{high school rank}) + b_7*(\text{SAT score}) + \varepsilon$

In this equation, $\hat{Y}$ equals the predicted outcome variable for GPA and "a" is the intercept when all independent variables are equal to zero. The model includes both demographic background characteristics (b1 through b5) and academic characteristics (b6 and b7). All of these parameters were estimated, but b1 is of particular interest because it represents dual credit. Finally, ε is an error term that accounts for the effect of unmeasured factors.

Figure 3.2 Graduation Research Model

$$Log\left[\frac{\hat{Y}(\text{graduation})}{(1-\hat{Y}(\text{graduation})}\right] = a + b_1*(\text{dual credit}) + b_2*(\text{race/ethnicity}) + b_3*(\text{gender}) + b_4*(\text{parental education}) + b_5*(\text{family income}) + b_6*(\text{high school rank}) + b_7*(\text{SAT score}) + \varepsilon$$

**DATA**

As detailed in the research models outlined above, this study examined how dual credit influences college GPA and graduation. To answer the research questions and examine the hypotheses, this study used extant, longitudinal state-level data obtained from the Texas Higher Education Coordinating Board (THECB). The data – which were de-identified by the THECB – were contained in six different files that included student-level administrative, admissions, and financial aid data collected between 2003 and 2012. Table A.1 in the appendix lists the THECB files that were used to construct the dual

credit database analyzed in this study. A number of other studies have used this data including Eklund (2009), Hamilton (2012) and Cullinane (2014). The files provided by THECB contained all of the demographic and academic information necessary for the analysis. The initial tasks prior to analyzing the data was cleaning, sorting, and combining the different files to create one record for each student. Each student who applies to a public institution of higher education in Texas receives a unique identification number that was de-identified for research purposes and used to merge data across administrative datasets. To help ensure the accuracy of the data, resources including Coordinating Board Manuals (CBM) and input from THECB staff were used for triangulation.

The final longitudinal dataset includes information about pre-college characteristics collected during the admissions process and student outcomes collected after students were enrolled at a four-year institution. Demographic information in the dataset includes: ethnic and racial identity, gender, parental education, and family income. The dataset includes the following academic characteristics: number of dual credit courses; SAT/ACT test scores; freshman college grade point average; and baccalaureate degree attainment. The information contained in this dataset allowed for the development of a study that analyzes college outcomes while statistically controlling for students' academic and demographic background characteristics. Due to the limitation of using available data, there are some additional variables that were not included that will be discussed in the limitations section of the chapter.

This research compares non-dual credit students with students who have taken dual credit courses prior to enrolling in a four-year college. Therefore, any transfer credits earned after a student enrolled at a four-year institution of higher education were excluded from the dataset because they are beyond the scope of this study. To ensure

that the study focuses on dual credit courses offered in Texas, the dataset included only students who attended high school and public colleges in Texas. And, finally, the study included only students who are first-time in college freshmen. The files provided by THECB contained records from 2003 to 2012. However, in order to track degree attainment within four years among the most recent graduates from the available data, only records from the 2008 cohort were examined. Tables 3.1 through 3.4 provide descriptive information about the cohort including the amount of dual credit taken by race, gender, parent education, and family income.

Table 3.1 Dual by Race

| | | Dual | | Non-Dual | |
|---|---|---|---|---|---|
| Race | Dual | % Total | Non-Dual | % Total | Total |
| White | 8,577 | 24% | 11,136 | 31% | 19,713 |
| Black | 967 | 3% | 3,078 | 9% | 4,045 |
| Hispanic | 3,409 | 9% | 4,541 | 13% | 7,950 |
| Other | 1,439 | 4% | 2,723 | 7% | 4,162 |
| TOTAL | 14,392 | 40% | 21,478 | 60% | 35,870 |

Table 3.2 Dual by Gender

| | | Dual | | Non-Dual | |
|---|---|---|---|---|---|
| Gender | Dual | % Total | Non-Dual | % Total | Total |
| Male | 6,146 | 17% | 10,565 | 30% | 16,711 |
| Female | 8,246 | 23% | 10,913 | 30% | 19,159 |
| TOTAL | 14,392 | 40% | 21,478 | 60% | 35,870 |

Table 3.3 Dual by Level of Parent Education

| | | Dual | | Non-Dual | |
|---|---|---|---|---|---|
| Parent Education | Dual | % Total | Non-Dual | % Total | Total |
| First Generation | 2,254 | 7% | 3,345 | 9% | 5,599 |
| Some College | 3,081 | 8% | 4,665 | 13% | 7,746 |
| Bachelors | 9,057 | 25% | 13,468 | 38% | 22,525 |
| TOTAL | 14,392 | 40% | 21,478 | 60% | 35,870 |

Source: Author Analysis of Texas Higher Education Coordinating Board Data

Table 3.4 Dual by Family Income

| | | Dual | | Non-Dual | |
|---|---|---|---|---|---|
| Family Income | Dual | % Total | Non-Dual | % Total | Total |
| Low Income | 2,993 | 8% | 5,228 | 15% | 5,599 |
| Middle Income | 4,086 | 12% | 5,801 | 16% | 7,746 |
| High Income | 7,313 | 20% | 10,449 | 29% | 22,525 |
| TOTAL | 14,392 | 40% | 21,478 | 60% | 35,870 |

Source: Author Analysis of Texas Higher Education Coordinating Board Data

As defined in the literature, underrepresented students include those who are first-generation, low-income, or from racial/ethnic minority groups. And, according to the Texas Higher Education Coordinating Board's *Closing the Gaps* plan, underrepresented racial/ethnic groups in Texas higher education include those who are African American and Hispanic, with males experiencing particularly low rates of success (THECB, 2011a).

Therefore, demographic information included in the dataset was used to filter the data to examine the effect of dual credit for underrepresented students, and particularly those who are black and Hispanic.

This study qualified for an exempt-status Institutional Review Status (IRB) from the University of Texas at Austin. The research was approved by a data committee at the Texas Higher Education Coordinating Board, which provided access to an existing de-identified state-level dataset. Therefore, individuals included in the study were passive participants, and no students were contacted for any additional data collection. The researcher had no interaction with the participants; therefore, there was no physical, psychological, or social risk to which they were exposed. Because the data are housed on a secured computer at THECB with a static IP address and located in a controlled-access space, there was minimal risk that data could be released. In summary, this secondary research drew on existing data and did not require the researcher to contact participants in order to conduct the analysis.

### MISSING DATA

The dataset was examined in order to detect any missing information. The following four variables, all of which are self-reported by students, were found to have missing data: gender, annual family income, SAT score, and parental education. The data were examined for missing patterns to determine if there was a large concentration of missing data from one particular institution or among specific sub-groups and no patterns were identified. Given the size of the sample, it is unlikely that the missing data introduced bias to the analysis (Wooldridge, 2009). Therefore, the data were assumed missing at random and omitted from computation using list wise deletion.

## VARIABLES

When developing a study and selecting variables for inclusion, one major goal is to exercise parsimony in construction the model; this requires including the fewest explanatory variables possible while providing as much information as possible about the dependent variable (King, Keohane, & Verba, 1994). Therefore, the variables included in this study are intended to be both parsimonious and theoretically grounded.

## DEPENDENT VARIABLES

Based on the research questions outlined above, the dependent variables are freshman first semester grade point average (which indicates level of academic preparation) and college graduation as measured by completion of a bachelor's degree within four years. These variables were selected because they measure college success and, based on the dual credit literature cited in Chapter 2, are thought to be positively influenced by participation in dual credit. The dependent variables are summarized in Table 3.6 and described in detail below.

**Freshman College GPA.** The dependent variable for the research question was freshman GPA after one semester of college. Grade point average was constructed as s continuous variable using data provided by THECB, including the number of semester credit hours attempted and the number of grade points earned. To obtain GPA, the number of semester credit hours was divided by the number of grade points earned. This provided a GPA score on a 4.0 scale for each student. This study examined the GPA from the first semester of the freshman year in order to determine whether high school dual credit course-taking influences academic performance at the beginning of college.

**College Graduation.** In the second research question, the dependent variable was college graduation within four years. This dichotomous variable was coded equal to 0 if students did not complete a bachelor's degree and 1 if students earned a degree.

## INDEPENDENT VARIABLES

The primary variable of interest for this study was dual credit participation. In addition, ten control variables were included in the analysis in order to account for student background characteristics and academic achievement. While the control variables are informed by the literature review, they are also limited based on the available data, which will be discussed further in the limitations section. The control variables, which are summarized in Table 3.5, are arranged in two categories: demographic characteristics and academic characteristics. The demographic characteristics category includes: race/ethnic identity, gender, parent education, and annual family income. The student academic characteristics category includes high school rank and SAT.

Table 3.5 Independent Variables

| Variable | Operationalization | Scale |
|---|---|---|
| **Log Sum Dual** | Total number of dual credit hours | (Natural Log of dual 0-98 scale) |
| **Race/Ethnicity** | White / Black / Hispanic / Other | (0=White, 1=Black, 2=Hispanic, 3=Other) |
| **Gender** | Male / Female | (0=Male, 1=Female) |
| **Parent Education** | First Generation = High School Below / Some College = Associate's or Less / College = Bachelor's, Grad or Professional | (0 = First Generation, 1=Some College, 2=College) |
| **Family Income** | Low: 39,000 or Less / Middle: 40 to 79,000 / High: 80,000 & up | (0=Low, 1=Middle, 2=High) |
| **High School Rank** | Top 10 (up to 10%) / Top 25 (11 to 25%) / Lower 75 (26% & below) | (0=Lower 75, 1=Top 25, 2=Top 10) |
| **SAT** | Total SAT score | (225-1600 scale) |

**Dual Credit.** The primary variable of interest for this study was dual credit participation, which was coded in three different ways. First, a dichotomous dual credit variable (referred to as dual) was also created. Dual was coded equal to 1 if students took at least one dual credit course and 0 if they did not. This variable was used for descriptive statistics and data cleaning.

Second, the total number of hours of dual credit each student transferred into the institution as a first-time in college freshman was constructed by adding the total number of hours of academic dual credit attempted by each student while in high school. In order to adjust a skewed distribution of the total number of hours, the natural logarithm of the original variable was used in this study. This variable was called sum dual hours and is used in the causal models.

The third dual credit variable (called dual composite) was created in the following manner. Dual composite was coded 0 if students did not take dual credit. It was coded 1 if students took between 1 and 11 hours of dual credit and it was coded 2 if students took 12 or more hours of dual credit. These three levels of dual credit enrollment were selected based on practice and research. Texas Legislation passed in 2006 requires that all high schools offer students the opportunity to earn a minimum of 12 college credit hours (HB 1, 2006). This legislation was informed by Early College High Schools, which allow students to earn up to 60 college credit hours (SB 1146, 2005) and by research on the intensity of course-taking in high school and college. (Adelman, 1999; McCormick & Carroll, 1999). The natural cut points in the data and the previous research and policy supported the three cut points: 0 hours, up to 11 hours, and 12 or more hours. As described in greater detail in the Methods of Analysis section, dual composite was used for descriptive statistics and ANOVA analyses.

**Race/ethnicity.** The race/ethnicity data are self-reported by students to the THECB in eight different categories. For the purposes of this study, race/ethnicity was combined into four variables: White, Black, Hispanic, and Other. The variable Other includes students who are classified in THECB data as Asian, American Indian, Hawaiian/Pacific Islander, and other. The creation of the Other category enabled the researcher to include sub-groups in the study that would have been excluded due to small sample sizes that might not have protected student identity (as required by the Texas Higher Education Coordinating Board). The four race/ethnicity variables are dichotomously coded 1 if a student self-identifies in a particular category and 0 if they do not.

**Gender.** A dichotomous variable for gender was provided by THECB using data that students self-reported on their college applications. The variable was coded 0 for male and 1 for female.

**Parent Education.** Level of parent education was reported by students on their college applications. The categories provided by THECB for mother's and father's education were: no high school; some high school no diploma; high school; some college; Associate; Bachelor's; Graduate/Professional; and unknown. These eight categories were used to create a parent education variable with three levels that was based on the definition of first-generation used by the National Center for Education Statistics: first generation, some college, and college (Chen, 2005). The highest level of education was selected if data was available for both parents. Otherwise the data for either father or mother was used to determine level of parent education. Parent education was coded 0 if the highest level of education was high school or below. It was coded 1 if the highest level of parent education was some college courses or an Associate's degree. Finally, parent education was coded 2 if the parent(s) earned a bachelor's or graduate degree.

**Family Income.** Level of annual family income was gathered by THECB through financial aid applications, which are optional for students to complete. The six income categories provided by THECB were used to construct a three-level variable: low income ($39,000 or Less), middle income ($40,000 to $79,000), high income ($80,000 and up), and unknown. Family income was coded 0 for low income, 1 for middle income and 2 for high income.

**High school Rank.** The THECB provided information about students who graduate from high school either in the top 10% or 25% of their class. This was used to create a three-level variable called rank. Rank was coded 1 if students were ranked in the top ten percent and 1 if students rank between the eleventh and twenty-fifth percentiles. The final level was imputed relative to the other two levels. Students who were neither in the top 10% nor in the top 25% are coded 2 and assumed to be ranked in the twenty-sixth percentile or below.

**SAT score.** The unstandardized SAT composite scores were used in the analyses to control for students' academic characteristics. In cases for students who provided ACT scores only, the researcher fitted ACT scores to the SAT scales using a concordance table developed by ACT and the College Board (ACT, 2009). The concordance table provided conversions for ACT composite scores of 11 to 36. Therefore, ACT scores from 11 to 36 were converted to their equivalent SAT scores. ACT scores lower than 11 were excluded based on the concordance tables, but all SAT scores were included. If a student had both a converted ACT score and an SAT score, the higher score was selected. This continuous variable ranges from 225 to 1600.

## METHODS OF ANALYSIS

All data collection was conducted by the Texas Higher Education Coordinating Board and all data analysis was conducted by the researcher at THECB using Stata, a proprietary statistical software package. An alpha level of $\alpha = .05$ was set for the study because this is most commonly-used statistical significance threshold in social and behavioral sciences (Gravetter & Wallnau, 2009; Wooldridge, 2009).

After re-coding variables and cleaning the data, the researcher examined descriptive statistics. Dual credit and non-dual credit students were examined based on the demographic and academic characteristics outlined above. Next, a Pearson's *r* correlation test was conducted in order to determine whether all of the independent variables included in the study were correlated with the dependent variables (Gujarati, 2003; Hamilton, 2009). Then, a series of one-way Analysis of Variance (ANOVA) tests and a t-test were run in order to discern whether there were significant differences within-groups for the independent and dependent variables.

ANOVA tests were first used to look for within-group differences for the two independent variables, GPA and dual credit, for students at three different levels of dual credit course-taking. Then, ANOVA tests were run based on the dependent variables. The within-group differences under examination for the dependent variables include: race/ethnic identity, first generation status, and family income (demographic characteristics) and rank and SAT (demographic characteristics). Meanwhile, an independent samples t-test was run for gender (demographic characteristic), since gender is a dichotomous variable.

The one-way ANOVA tests were conducted using the variable dual composite, which includes the following three levels: no dual, 11 or fewer hours, and 12 or more hours, in order to determine if there are differences in characteristics by dual credit hour

categories. When the ANOVA test identified significant mean differences in characteristics by dual credit hour categories, Scheffe post-hoc tests were conducted to ascertain pairwise differences. After initial analysis that included Bartlett's test for equal variances, both dependent variables met the assumption that the variances of the dependent value is the same across the groups being studied.

The first research question specifically focused on examining characteristics in dual credit enrollment for underrepresented students. Therefore, the t-test and ANOVA results (for race, gender, parent education, and family income) were used to address research question one. All of the information gathered from the t-test and ANOVA analyses also provided a starting point for understanding the relationships between variables prior to conducting multivariate regression analysis.

The purpose of using a multiple regression model is to test relationships and identify the best combination of independent variables that provides the most information about dual credit. Therefore, if the independent variables are too highly correlated to one another (or multicollinear), it is problematic because they account for the same explained variance in the outcome measure; as a result, it is difficult to discern which variables have the greatest impact on the outcome of interest. In order to identify and address multicollinearity, the researcher conducted the variance inflation factor test. The knowledge of these relationships between variables was used to gather a full understanding of the dataset.

Research question two used multiple linear regression to examine freshman college grade point average (model summarized in Figure 3.1). There are three underlying assumptions that were met in order to conduct multivariate regression analysis (Gujarati, 2003; Hamilton, 2009). The first and most fundamental assumption is that data are normally distributed because non-normal data can distort the relationships between

variables. This assumption was addressed by checking skewness and kurtosis for each variable. The second assumption is that there are linear relationships between the independent and dependent variables. If these associations are not identified and addressed, the regression analysis will not correctly predict the relationships between variables. According to the Pearson product-moment correlation test, all independent variables included in the final analysis were found to be significantly associated with both of the dependent variables, GPA and graduation (see Table A.2 in the appendix for results). The third assumption is that each predicted value is independent (or reliable). In multiple regression each additional variable that is added to an equation increases the risk that "the variance accounted for is not apportioned correctly" (Osborne & Waters, 2002, n.p.). All variables were found to be independent based on results from the variance inflation factor test. Therefore, all three assumptions were met.

The third research question employs binary logistic regression, which makes the following assumptions. The first assumption is that the dependent variable is binary and the second assumption is that there are one or more independent variables. The third assumption is that observations are independent and that the dependent variable has categories that are mutually exclusive and exhaustive. Finally, logistic regression assumes that there is a linear relationship between the logit transformation of the dependent variable and any continuous independent variables; this is demonstrated by the binary logistic equation for graduation in Figure 3.2. In this analysis, the dependent variable, graduation, includes two mutually exclusive, dichotomous levels – completed a degree and did not complete a degree. There are multiple independent variables, as detailed above in the description of variables. Since all assumptions of binary logistic regression have been met, this is a valid analytic model to examine how dual credit influences the likelihood of graduation, by controlling for other factors.

## LIMITATIONS

A significant limitation associated with studying dual credit is selection bias among students and institutions of higher education. In order to ensure academic rigor in college-level courses, institutions of higher education generally set admission requirements that students must meet to enroll in dual credit courses. According to Waits, Setzer, and Lewis (2005) 62% of programs nationwide have admission requirements including: minimum grade level (84%), grade point average (48%), and standardized test score (38%). Therefore, students who take dual credit do so based on a demonstrated level of academic ability. While participation requirements are intended to ensure that students are prepared for college-level coursework, they pose a challenge for researchers.

If students are academically high achieving before enrolling in dual credit, researchers must purposefully design studies that account for this and allow for the effects of dual credit to be examined independent of prior academic achievement (Bragg, 2006; Bragg, Kim & Rubin, 2005; Karp & Jeong, 2008; Lerner & Brand, 2006). This limitation is addressed to the degree possible, by controlling for the two measures of achievement that are currently available in state-level data, SAT and high school rank.

It is important to note that class rank is calculated using high school grade point average. Some school districts weight high school grade point average based on participation in advanced coursework (such as dual credit and Advanced Placement). As a result, there is a potentially confounding correlation between high school class rank and dual credit. However, the way that grade point average is calculated in high schools is neither uniform nor universal. For example, some districts may weight AP courses, but not dual credit courses. Because this level of information is not collected in available

state-level data, one should understand that this potential limitation cannot be further addressed.

Dual credit students may have unobserved characteristics – such as higher levels of motivation, parental support, or expected returns from participation in dual credit – which differentiate them from their peers who do not enroll in dual credit. For example, a student who is college-bound may enroll in dual credit in order to demonstrate ability to complete college-level coursework. While the possibility of unobserved characteristics can be acknowledged, it cannot be accounted for in the research design. In addition to individual characteristics that can limit the study, there are also institutional characteristics that must be considered.

All educational institutions, including both high school and college campuses, present environmental factors such as peers, teachers, facilities, and resources that can influence a student's propensity to excel academically (such as the number of students who take SAT and AP exams). These contextual effects may impact student success, but are difficult to measure and control in a quantitative study. Therefore, another limitation of this study is that it was not possible to not include control variables for either high school or college-level environmental characteristics. If these controls are available for future studies, it would be ideal to include them.

# Conclusion

Dual credit continues to be implemented as a mechanism for increasing college readiness and engaging students who are underrepresented in college. Examining the college-level outcomes of students who take dual credit enables education stakeholders to develop policies and practices that support student success while increasing efficiency and effectiveness. The current literature calls for continued investigation of dual credit

courses with an emphasis on statistically controlling for students' background characteristics and prior academic achievement. Very few studies have conducted this type of research. Therefore, this study seeks to add to the growing body of literature on dual credit by addressing questions about the relationship between dual credit and student success in higher education.

# CHAPTER 4: RESULTS

## Overview

This chapter presents the results of a quantitative study of dual credit conducted with longitudinal state-level data obtained from the Texas Higher Education Coordinating Board. This study is guided by three research questions:

1. Are there differences in dual credit enrollment for underrepresented students?
2. What is the relationship between dual credit and academic preparation, as measured by freshman grade point average?
3. How does dual credit influence the probability of college graduation?

There are three sections in this chapter. The first section outlines the analytic model used in the study and the variables related to each concept. The second section provides preliminary findings based on descriptive analysis of the data. The final section presents the results of the three research questions.

### EMPIRICAL STRATEGY

The first two phases of analysis included running descriptive statistics, ANOVAs, and t-tests to examine and understand the relationships between the dependent and independent variables (as explained in Chapter 3). The outcomes for four variables (race, gender, parent education, and family income) were of particular interest for research question one, which asks if there are differences in dual credit enrollment for underrepresented students. The final phase of analysis used multivariate analysis to test the effect of dual credit on college outcomes, including freshman GPA (using OLS regression) and college graduation (using binary logistic regression).

# Descriptive Analysis

## FINDINGS

The final longitudinal dataset contained 35,870 students who enrolled in college for the first time at public four-year institutions of higher education in Texas in 2008. Among all students in the sample, 40% took dual credit and 60% did not take dual credit. The sample was 53% female and 47% male and was distributed across four racial/ethnic groups: white (55%), Hispanic (22%), black (11%) and other (12% including Asian, Native American and Pacific Islander). Based on summary statistics, the sample is representative of demographics in higher education in Texas. More details about descriptive statistics of dependent and independent variables are displayed in tables 4.1 through 4.4.

Table 4.1: Numbers and Percentages of Sample for Independent Categorical Variables

| Variable | N | % |
|---|---|---|
| **Dual Credit** | | |
| No Dual | 21,478 | 60% |
| Dual 11 or Fewer | 8,247 | 23% |
| Dual 12 or More | 6,145 | 17% |
| **Gender** | | |
| Male | 16,711 | 47% |
| Female | 19,159 | 53% |
| **Race** | | |
| White | 19,713 | 55% |
| Black | 4,045 | 22% |
| Hispanic | 7,950 | 11% |
| Other | 4,162 | 12% |
| **Parent Education** | | |
| First Generation | 5,599 | 16% |
| AA/Some College | 7,746 | 21% |
| College | 22,525 | 63% |
| **Family Income** | | |
| Low Income | 8,221 | 23% |
| Middle Income | 9,887 | 28% |
| High Income | 17,762 | 49% |
| **HS Rank** | | |
| Lower 75 | 13,687 | 38% |
| Top 25 | 10,892 | 30% |
| Top 10 | 11,291 | 32% |
| **TOTAL** | 35,870 | 100% |

Source: Texas Higher Education Coordinating Board

Table 4.2: Dependent Variable Descriptive Statistics

| Variable | M | SD | Min | Max | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| GPA | 2.951 | .876 | .5 | 4.0 | -.724 | 3.019 |
| Graduation | .364 | .481 | 0 | 1 | .564 | 1.318 |

Source: Author Analysis of Texas Higher Education Coordinating Board Data

Table 4.3: Independent Variable of Interest Descriptive Statistics

| Variable | M | SD | Min | Max | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Continuous Dual (sum dual log) | .932 | 1.201 | 0 | 4.595 | .711 | 1.885 |
| Categorical Dual | 1.573 | .766 | 1 | 3 | .587 | .897 |

Source: Author Analysis of Texas Higher Education Coordinating Board Data

Table 4.4: Independent Control Variable Descriptive Statistics

| Variable | M | SD | Min | Max | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Gender | .534 | .499 | 0 | 1 | -.137 | 1.019 |
| Race | | | | | | |
| White | .550 | .498 | 0 | 1 | -.199 | 1.040 |
| Black | .113 | .316 | 0 | 1 | 2.448 | 6.994 |
| Hispanic | .222 | .415 | 0 | 1 | 1.340 | 2.797 |
| Other | .116 | .320 | 0 | 1 | 2.398 | 6.750 |
| Parent Education | 2.472 | .749 | 1 | 3 | .561 | -1.017 |
| Family Income | 2.266 | .808 | 1 | 3 | -.519 | 1.718 |
| HS Rank | 1.933 | .832 | 1 | 3 | .125 | 1.456 |
| SAT | 1090 | 176.66 | 375 | 1600 | -.091 | 3.027 |

Source: Author Analysis of Texas Higher Education Coordinating Board Data

## RESULTS OF ONE-WAY ANOVA ON DEPENDENT VARIABLES

One-way ANOVA analyses were conducted to determine whether there were mean differences on the two key predictors – GPA and dual credit – for students at three different levels of dual credit course-taking including: no dual credit, 11 or fewer hours of dual credit, and 12 or more hours of dual credit. The results of the ANOVA analyses for GPA and graduation are presented in Table 4.5 and discussed as follows.

Table 4.5: One Way ANOVA Results for Independent Variables: GPA and Graduation

| | N | M | SD | df | F | Post-hoc |
|---|---|---|---|---|---|---|
| **GPA** | | | | | | |
| (a) No Dual | 21,478 | 2.76 | .896 | 2 | 1343.35*** | a-b*** |
| (b) Dual 11 or Fewer | 8,247 | 3.16 | .811 | 35867 | | b-c*** |
| (c) Dual 12 or More | 6,145 | 3.32 | .690 | 35869 | | a-c*** |
| **Graduation** | | | | | | |
| (a) No Dual | 21,478 | .313 | .464 | 2 | 385.97*** | a-b*** |
| (b) Dual 11 or Fewer | 8,247 | .394 | .488 | 35867 | | b-c*** |
| (c) Dual 12 or More | 6,145 | .500 | .500 | 35869 | | a-c*** |
| TOTAL | 35,870 | | | | | |

Significance indicated by *p<.10, **p<.05, ***p<.01

**GPA.** There was a significant relationship between dual credit participation and freshman GPA shown by significance in the ANOVA analysis results: [F(2, 35,867) =

1343, p = .000]. Based on the significant F-statistics in the ANOVA test, a post-hoc test was required to further explore the relationship between dual credit and GPA. The Scheffe post-hoc test indicated that the mean score for 11 or fewer hours of dual credit ($M_{GPA}$=3.16, $SD_{GPA}$=.81) was significantly different from no dual credit ($M_{GPA}$=2.77, $SD_{GPA}$=.90). And, taking 12 or more hours of dual credit ($M_{GPA}$=3.32, $SD_{GPA}$=.69) was also significantly different than taking no dual credit. This suggests that dual credit does have an effect on freshman GPA. According to this analysis, students who do not take dual credit have a mean GPA of 2.77, students who take up to 11 hours have a mean GPA of 3.16 and those who take 12 or more hours have a mean GPA of 3.32. One of the study's hypotheses is that dual credit students have higher GPAs than non-dual credit students; the ANOVA and Scheffe results suggest that further investigation of the relationship between dual credit and freshman GPA is warranted.

**Graduation.** For the second key variable of interest, college graduation, ANOVA results indicated that there was a significant relationship between graduating from college and the three levels of dual credit course-taking: [F(2, 35,867)=386, p=.000]. A Scheffe post-hoc test was conducted to obtain additional information about the nature of the relationship between college graduation and levels of dual credit course-taking. The results indicated that students with no dual credit ($M_{Graduation}$=.31, $SD_{Graduation}$=.46) were less likely to graduate from college than students who took 11 or fewer hours of dual credit ($M_{Graduation}$=39, $SD_{Graduation}$=.49). An even larger difference in likelihood of graduating was found when students with 12 or more hours ($M_{Graduation}$=.50, $SD_{Graduation}$=.50) were compared with the other two groups. These results suggest that there is a relationship between dual credit course-taking and college graduation. However, the supposition that dual credit increases the likelihood of graduating from college must be carefully examined through multivariate regression.

## RESULTS OF ONE-WAY ANOVA ON INDEPENDENT VARIABLES

In order to answer research question one, a second set of ANOVA analyses was conducted to examine the mean differences for the control variables included in the multivariate models. One-way ANOVA was performed on the following variables: academic characteristics (rank and SAT) and demographic characteristics (race/ethnic identity, parent education, and family income). An independent samples t-test was run on gender. The independent variables were analyzed by level of dual credit participation, ranging from no dual credit to 11 or fewer hours to 12 or more hours. In each instance where ANOVA results indicated that there were significant relationships between variables, Scheffe post-hoc tests were run in order to further analyze the relationships.

The ANOVA results (displayed in Tables 4.6 to 4.8) showed significant between-group mean differences for all variables – except parent education. The results for race/ethnicity, gender, parent education, and family income are discussed in research question one and the results for rank and SAT are discussed as follows.

**Rank.** The relationship between dual credit and all levels of high school rank is significant according to ANOVA and post-hoc analyses [$F(2, 35{,}867) = 54.37$, $p = .000$]. Students in the top 10% of their high school class take the most dual credit ($M_{Top10}=1.24$, $SD_{Top10}=1.30$), followed by students in the top 25% of their class ($M_{Top25}=1.01$, $SD_{Top25}=1.20$) and finally, students in the lower 75% of their class ($M_{Lower75}=.618$, $SD_{Lower75}=1.03$). Considering that students who are more highly-ranked tend to take more advanced coursework, these results are expected.

**SAT.** The relationship between SAT and dual credit is significant. Non-dual students ($M_{NoDual}=1082$, $SD_{NoDual}=186$) have a lower mean SAT score than students who took either 11 or fewer hours of dual credit ($M_{Dual11}=1103$, $SD_{Dual11}=164$) or 12 or more hours ($M_{Dual12}=1101$, $SD_{Dual12}=158$). Overall, the differences between mean SAT scores

across the three levels of dual credit course-taking is less than 100 points. Post-hoc analysis indicates that the mean differences for SAT exist between dual- and non-dual students. However, there is no significant difference between students who took fewer than 11 hours and students who took 12 or more hours.

Table 4.6: One Way ANOVA Results: Sum Dual with Independent Variables

| Variable | N | M | SD | df | F | Post-hoc |
|---|---|---|---|---|---|---|
| **Race** | | | | | | |
| (a) White | 19,713 | 1.00 | 1.210 | 3 | 232.63*** | a-b*** |
| (b) Black | 4,045 | .517 | .967 | 35866 | | b-c*** |
| (c) Hispanic | 7,950 | 1.04 | 1.270 | 35869 | | c-d*** |
| (d) Other | 4,162 | .782 | 1.133 | | | a-d***<br>b-d*** |
| **Parent Education** | | | | | | |
| (e) First Generation | 5,599 | .951 | 1.23 | 2 | .91 | |
| (f) AA/Some College | 7,746 | .923 | 1.20 | 35867 | | |
| (g) College | 22,525 | .931 | 1.19 | 35869 | | |
| **Family Income** | | | | | | |
| (h) Low Income | 8,221 | .853 | 1.19 | 2 | 23.65*** | h-i*** |
| (i) Middle Income | 9,887 | .962 | 1.21 | 35867 | | |
| (j) High Income | 17,762 | .952 | 1.20 | 35869 | | h-j*** |
| **HS Rank** | | | | | | |
| (k) Lower 75 | 13,687 | .618 | 1.03 | 2 | 902.89*** | k-l*** |
| (l) Top 25 | 10,892 | 1.01 | 1.20 | 35867 | | l-m*** |
| (m) Top 10 | 11,291 | 1.24 | 1.30 | 35869 | | k-m*** |
| TOTAL | 35,870 | | | | | |

Significance indicated by *p<.10, **p<.05, ***p<.01
Source: Author Analysis of Texas Higher Education Coordinating Board Data

Table 4.7: Independent Sample T-test: Sum Dual and Gender

| Variable | N | M | SD | df | t |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| (a) Male | 16,711 | 2.88 | .895 | | -15.443*** |
| (b) Female | 19,159 | 3.02 | .854 | | |
| | | | | 34,698.8 | |
| TOTAL | 35,870 | | | | |

Significance indicated by *p<.10, **p<.05, ***p<.01
Source: Author Analysis of Texas Higher Education Coordinating Board Data

Table 4.8: One Way ANOVA Results: Dual Composite and SAT

| Variable | N | M | SD | df | f | Post-hoc |
|---|---|---|---|---|---|---|
| **SAT** | | | | | | |
| (a) No Dual | 21,478 | 1082.3 | 185.89 | 2 | 54.37 | a-b*** |
| (b) Dual 11 or Fewer | 8,247 | 1103.1 | 163.80 | 35867 | | |
| (c) Dual 12 or More | 6,145 | 1100.5 | 157.62 | 35869 | | a-c*** |
| TOTAL | 35,870 | | | | | |

Significant relationships indicated by ***
Source: Author Analysis of Texas Higher Education Coordinating Board Data

# Analytic Results by Research Question

### QUESTION ONE: DUAL CREDIT & UNDERREPRESENTED STUDENTS

Research question one asks if there are differences in dual credit enrollment for underrepresented students. This question is answered using an independent samples t-test and one-way ANOVA with post-hoc tests to examine dual credit enrollment by race, gender, parent education, and family income. The between-group differences were statistically significant ($p<.05$) for race/ethnicity, gender, and income, but not parent education. Tables 4.6 and 4.7 provide detailed information.

**Race/Ethnicity.** The relationship between level of dual credit participation and racial/ethnic identify was significant for all groups except Hispanics, according to ANOVA analysis [F(3, 35,866) = 232.63, p = .000]. Black students take the fewest dual credit courses and this was identified as significant ($M_{Black}$=.517, $SD_{Black}$=.895). Hispanic students take the most dual credit, but it is not significant. Therefore, students who identify as White and Other take the most dual credit and it is significant for both groups. Whites take the highest amount ($M_{White}$=1.01, $SD_{White}$=1.21), followed by Other students ($M_{Other}$=.782, $SD_{Other}$=1.13).

**Gender.** There is a significant relationship between gender and dual credit enrollment t(34,698)=-15.44, p=.000. In particular, female students ($M_{Female}$=3.02, $SD_{Female}$=.854) take more dual credit than male students ($M_{Male}$=2.88, $SD_{Male}$=.895).

**Family Income.** Level of family income and dual credit has a significant relationship [F(2, 35,867) = 23.65, p = .000]. However, the particular level of income does matter, according to post-hoc analysis. Students from low-income families take the least dual credit ($M_{LowInc}$=.853, $SD_{LowInc}$=1.19) while students from middle-income families take the most dual credit ($M_{MiddleInc}$=.962, $SD_{MiddleInc}$=1.21) and the difference is significant. There is also a significant mean difference between low- and high-income students ($M_{HighInc}$=.951, $SD_{HighInc}$=1.20). However, there is no significant mean difference in dual credit between middle- and high-income students.

As described in the literature reviewed in Chapter 2, underrepresented students in Texas are individuals in any of the following groups: first-generation, low-income, minority and/or male. Question one hypothesized that underrepresented students have lower levels of enrollment in dual credit than their peers. Using t-tests and ANOVA analyses, this study found that black students take the least dual credit among all racial/ethnic groups and the difference is significant. Meanwhile, females take more dual

credit courses than males. And students from middle-income families take the most dual credit while students from low-income families take the least. Finally, there are no significant differences in dual credit course-taking based on level of parental education. Among underrepresented students, the differences are significant and lower for students who are black or male or low-income. In light of these findings, it is notable that while Hispanic students take more dual credit than students of all races, the difference is not significant. These significant (and insignificant) differences in dual credit course taking between students who are underrepresented in higher education raise an important question about dual credit. If some groups of students are taking more dual credit than others while in high school, does it lead to different college outcomes? Therefore, these findings also signal that additional analysis of dual credit outcomes is necessary and important.

**QUESTION TWO: DUAL CREDIT & GPA**

Research question two, which examines the effect of dual credit on freshman GPA, was analyzed using multiple Ordinary Least-Squares (OLS) regression. Associations among independent and dependent variables were checked with correlation tests and all independent variables were significantly related with the dependent variable. Also, no multicollinearity of variables was found using variance inflation factor (VIF) tests. Two regression models were presented. Model 1 provided a baseline for the relationship between grade point average and dual credit. Model 2 added demographic and academic control variables. The F statistics, $R^2$ values, change in $R^2$, and significance of regression coefficients were analyzed for each model. The results of the OLS regression models for GPA are presented in Table 4.9 The column labeled β

provides regression coefficients measured in standard deviations in order to compare the relative strength of predictors in the model ("Regression with Stata, n.d.)

Table 4.9: GPA OLS Regression Results for Student Variables

| | Model 1 | | | | Model 2 | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **b** | **β** | **SE** | **t** | **b** | **β** | **SE** | **t** |
| **Sum Dual** | .193*** | .224 | .004 | 52.10 | .145*** | .199 | .004 | 41.16 |
| **Race** | | | | | | | | |
| Black | | | | | -.170*** | -.061 | .015 | -11.60 |
| Hispanic | | | | | -.057*** | -.027 | .011 | -5.08 |
| Other | | | | | .093*** | .032 | .014 | 6.53 |
| **Gender** | | | | | | | | |
| Female | | | | | .159*** | .090 | .008 | 18.89 |
| **Parent Education** | | | | | .058*** | .049 | .007 | 8.79 |
| **Family Income** | | | | | .034*** | .032 | .006 | 5.55 |
| **HS Rank** | | | | | .225*** | .214 | .005 | 41.70 |
| **SAT** | | | | | .001*** | .204 | .000 | 35.89 |
| **Constant** | | | | | .995** | .202 | .032 | 30.72 |
| n | | | | | 35,870 | | | |
| $R^2$ | .0704 | | | | .2230 | | | |
| F value | 2714.55*** | | | | 1143.74*** | | | |

Significance indicated by *p<.10, **p<.05, ***p<.01
Source: Author Analysis of Texas Higher Education Coordinating Board Data

Model 1, which examined the main effect of dual credit, explained 7% of the variance in freshman GPA ($R^2$ = .07, F (1, 35,868) = 2714.55, p<.0000) and found that dual credit is a significant predictor of freshman GPA (b = .193, p <.000). Model 2, which controlled for student demographic and academic characteristics, has a comparison group that includes white students for race variables and males for the gender variable. A comparison of $R^2$ between the two models indicated that Model 2 improved the model fit and predictive ability compared to the intercept-only model. By including control variables, Model 2 explained 22% of variance in GPA ($R^2$ = .223, F (9, 35,860) = 1143.74, p<.0000). In the full model, dual credit remained a strong and significant predictor of freshman GPA (b = .145, p = .000), when controlling for other variables.

When controlling for other variables, the strongest predictor of freshman college GPA is the academic control variable high school rank (b = .225, p = .000). In this model, being female is associated with a higher GPA (b = .159, p = .000) when controlling for other variables. Compared to their white peers, black and Hispanic students are more likely to have lower GPAs, when controlling for other variables. However, the negative effect is higher for black students (b = -.170, p = .000) than Hispanic students (b = -.057, p = .000) when controlling for other variables. Meanwhile, students classified in the Other category have higher GPAs than their white classmates (b = .093, p = .000) when controlling for other variables.

When controlling for other variables, each increase in the level of parent education – from first-generation to an Associate's degree to a bachelor's degree – is associated with a positive increase in GPA (b = .058, p = .000). Family income also has a significant, positive effect on GPA (b = .034, p = .000) as it moves from low- to middle- to high-income, when controlling for other variables. When the effect of academic characteristics is compared to the effect of demographic characteristics, the

former variables have a larger and more positive effect on GPA than the latter. It is notable that among all independent control variables, the two that are negatively associated with GPA are the black and Hispanic race variables. Overall, there is a positive, significant relationship between dual credit and academic preparation, as measured by freshman GPA.

### QUESTION THREE: DUAL CREDIT & GRADUATION

The third research question asks whether dual credit influences the probability of college graduation. The comparison group includes students who are white and male. Two models were run using binary logistic regression. The first model established the baseline relationship between dual credit and college graduation and is statistically significant based on its chi square statistics ($\chi^2$ = 738.45, p < .000 with df = 1). The second model was regressed on graduation with demographic and academic characteristics. A test of the full model against model 1 which contains the primary independent variable (summarized in Table 4.10) was statistically significant, indicating that the control variables reliably distinguished between students who graduated and those who did not ($\chi^2$ = 5527.06, p < .000 with df = 9). These models are summarized in Table 4.10 The " Change in Probability" column in Table 4.10 reports marginal effects (or instantaneous rates of change) at the mean of the independent variables; therefore, the Probability column may be interpreted in a manner similar to OLS regression as comparing the relative strength of predictors in the model (Boggess, 2007; Fernandez, 2004; Williams, 2015). The odds ratio are described in Chapter 4 and the "Change in Probability" will be discussed in Chapter 5.

Table 4.10: Graduation Logistic Regression Results for Student Variables

| | Model 1 | | | | Model 2 | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **b** | **SE** | **Odds Ratio Exp(b)** | **Change in Probability** | **b** | **SE** | **Odds Ratio Exp(b)** | **Change in Probability** |
| **Sum Dual** | .246*** | .012 | 1.279 | .0568*** | .172*** | .009 | 1.18*** | .0387*** |
| **Race** | | | | | | | | |
| Black | | | | | -.373*** | .047 | .688*** | -.0794*** |
| Hispanic | | | | | -.244*** | .033 | .783*** | -.0535*** |
| Other | | | | | .026 | .040 | 1.026*** | .0057 |
| **Gender** | | | | | | | | |
| Female | | | | | .794*** | .025 | 2.211*** | .1750*** |
| **Parent Education** | | | | | .184*** | .020 | 1.207*** | .0413*** |
| **Family Income** | | | | | .188*** | .018 | 1.21*** | .0422*** |
| **HS Rank** | | | | | .447*** | .015 | 1.563*** | .1002*** |
| **SAT** | | | | | .002*** | .000 | 1.002*** | .0005*** |
| Model $\chi^2$ | 738.45 | | | | 5527.06 | | | |
| Pseudo $R^2$ | .0157 | | | | .1175 | | | |
| Log Likelihood | -23155.39 | | | | -.20761.084 | | | |
| -2 Log Likelihood | 46310.78 | | | | 41522.168 | | | |

Significance indicated by *p<.10, **p<.05, ***p<.01
Source: Author Analysis of Texas Higher Education Coordinating Board Data

The results of Model 2 indicate that all of the academic and demographic control variables were significantly associated with graduation, except the racial/ethnic category predictor "Other". The highest predictor of college graduation is being female ($Exp(b)_{Female}$ = 2.21, p = .000), when controlling for all other factors. Compared to their

male counterparts, female students are more 2.21 times likely to graduate. Meanwhile, Black and Hispanic students are less likely to graduate from college than students from all other racial/ethnic groups. However, Hispanic students are slightly more likely to graduate from college than black students ($Exp(b)_{Black} = .688$, $p = .000$) than for Hispanic students ($Exp(b)_{Hispanic} = .783$, $p = .000$), when controlling for all other factors.

Parent education and family income have significant positive effects on graduation. For each increase in the level of family income, the odds of graduating from college are 1.21 times higher ($Exp(b)_{Family\ Income} = 1.21$, $p = .000$). For example, a student from a middle-income family is 1.21 times more likely to complete a bachelor's degree than a student from a low-income family. Students from high-income families are 1.21 times more likely to graduate with a bachelor's degree than students from middle-income families.

The way in which parent education influences the likelihood of college graduation is very similar to how family income influences graduation, when controlling for all other variables. As level of parent education increases, the likelihood of graduating from college increases by 4.1% ($Exp(b)_{Parent\ Ed} = 1.21$, $p = .000$). Thus, a student whose parent(s) have an Associate's degree or some college is 1.21 times more likely to graduate from college than a first-generation student. If parent(s) obtain a bachelor's or graduate degree, their child is 1.21 times more likely to obtain a bachelor's degree than children whose parent(s) completed an Associate's degree.

The academic control variables high school rank and SAT are associated with a higher likelihood of college graduation. Each increase in high school rank is associated with a positive increase in the probability of high school graduation ($Exp(b)_{Rank} = 1.56$, $p = .000$). For example, students who graduate in the top 25% of their high school class have 1.56 times higher odds of graduating than students in the lower 75% of their class,

when controlling for other factors. Meanwhile, each one-point increase in SAT score is associated with a 1.002 increase in the odds of college graduation.

Research question three hypothesizes that dual credit students are more likely to earn their bachelor's degrees than non-dual credit students. According to the results of this analysis, when controlling for other factors dual credit students are more likely to graduate from college than their non-dual credit peers. Based on analysis if the continuous dual credit variable sum dual hours, each hour of dual credit increases the odds of college graduation by 1.18 times that of non-dual students ($Exp(b)_{Dual} = 1.18$, $p = .000$). In terms of control variables, gender has the greatest effect on the probability of college graduation. When statistical controls are applied, females are far more likely to graduate than males. High school rank is the second highest predictor of graduation after being female. Meanwhile, race has a significant effect, but it is negative; students who are black and Hispanic are less likely to graduate than their white peers. The effects of parent education and family income on college graduation are also positive.

# CHAPTER 5: DISCUSSION & CONCLUSIONS

## Summary of Study

Texas educators continue seeking to increase the number of students who successfully complete college degrees. As a result, there has been an intense focus on ensuring that students are "college ready" by the time they graduate from high school. Research has found that completing a rigorous high school curriculum can increase persistence and success in college, particularly for the growing number of underrepresented students who are entering higher education (Adelman, 1999; Gullatt and Jan, 2003). It is within this context that the practice of offering college courses for high school credit (or dual credit) has expanded dramatically in recent years.

Dual credit enrollment has grown, in part, because it has become more widely-available to students. When the concept of dual credit was first conceived, it was designed for high-achieving, college-bound students. However, in recent years, it has been implemented as a tool for introducing students – especially those who may not be considering college – to the rigor and expectations of college while they are still in high school. While the number of students taking dual credit has grown significantly, research on dual credit has been limited for a number of reasons. First and foremost, because dual credit co-exists in both K-12 and higher education, it did not gain significant attention until enrollment in dual credit courses grew. Second, and more practically, longitudinal data sets either have not been available or did not include the data elements necessary to properly apply statistical controls.

Dual credit continues to grow but there is limited empirical evidence about its impact on college outcomes. Having an understanding of whether and how dual credit impacts college success and completion has important implications for policy and

practice. Therefore, this study sought to examine the effect of dual credit on college GPA after the freshman year and likelihood of college graduation. Based on the knowledge that dual credit is often used as a mechanism for supporting underrepresented students, who are less likely to attend and complete college, the study also investigated the characteristics of students who take dual credit. This chapter provides a brief overview of the research, including a summary of descriptive results. Its main focus is a synthesis of multivariate results by research question and a discussion of implications for practice, policy, and research.

## OVERVIEW OF RESEARCH

Using Human Capital Theory (Becker, 1993) and Academic Capital Formation (St. John et al., 2011), this study examined the effect of dual credit on college outcomes, specifically freshman GPA and college graduation. According to Becker's Human Capital Theory, dual credit enables students to optimize their human capital and receive maximum benefits by accumulating college credits in high school. Meanwhile, Academic Capital Formation posits that access to advanced courses promotes academic achievement and allows students to acquire college knowledge and social navigation skills. Taken together, these two theories provide a framework for conceptualizing and testing the effects of dual credit on college outcomes. The two frameworks are particularly useful for considering how dual credit can serve underrepresented students who benefit from acquiring and using knowledge and skills to navigate educational systems.

In order to examine dual credit, this study relied on extant state-level data for to answer the three research questions that guided the study. This quantitative study employed both descriptive and multivariate analyses in order to test the hypotheses. The first research question examined characteristics of dual credit enrollment for underrepresented students through an independent samples t-test (for gender) and one-way ANOVAs (for race, parent education, and family income). The second research question considered the effect of dual credit on freshman GPA in college using Ordinary Least Squares (OLS) regression. The third question analyzed the odds of college graduation based on dual credit course-taking through binary logistic regression.

## SUMMARY OF DESCRIPTIVE RESULTS

The research sample of 35,870 students is 53% female and 47% male. The racial/ethnic distribution is 55% white, 22% Hispanic, 11% black, and 12% other (including Asian, Native American and Pacific Islander). Forty percent of students took dual credit and 60% did not.

Initial descriptive analysis using ANOVAs and t-tests found that students who take dual credit have higher freshman college GPAs than their non-dual classmates (2.17). Specifically, students who take four or more courses have slightly higher GPAs (3.32) on average than students who take approximately three courses (3.16). And, descriptive statistics suggest that there is a relationship between dual credit and college graduation. According to ANOVA results, students who take four or more dual credit classes are most likely to graduate. The descriptive analysis of GPA and college graduation indicated that additional analysis of the effect of dual credit was warranted.

## QUESTION ONE: DUAL CREDIT & UNDERREPRESENTED STUDENTS

Prior to using multivariate statistics it was also helpful to see if a student's demographic characteristics affected their participation in dual credit. Therefore, research question one examined whether there are differences in dual credit enrollment for underrepresented students as defined by race, gender, parent education, and family income. According to national and state data, black and Hispanic students, males, low-income students, and first-generation students are underrepresented in higher education. Based on the literature and the theoretical frameworks, this study hypothesized that underrepresented students would have lower enrollment in dual credit than their peers.

In order to understand the dual credit course-taking patterns for underrepresented students, a t-test and ANOVAs with post-hoc tests were conducted on the four categories outlined above. Three of the four categories, including race/ethnicity, gender, and family income had significant between group differences based on significant F statistics (race/ethnicity and family income) and t statistic (gender). These significant differences both support the hypothesis that underrepresented students have lower enrollment in dual credit and raised some important considerations.

When dual credit enrollment was examined by racial/ethnic category the results were informative but in an unexpected way. The hypothesis that underrepresented students – in this case black and Hispanic students – take fewer dual credit courses is partially confirmed. On average, Hispanic students take the most dual credit courses, followed in descending order by students who are white, other, and black. The mean difference in dual credit course-taking is significant for all groups, except Hispanic

students. The ANOVA results indicate that additional predictor variables should be included in order to fully understand the effect of race. These results will be considered in greater depth in the analysis of multivariate results.

Dual credit enrollment by gender and family income also provided insights related to underrepresented students. Females, who represent more than half of the sample (53%), take more dual credit than males, who are underrepresented in higher education, and the difference is significant. Similarly, middle- and high-income students, take more dual credit than their low income peers, and the difference is significant.

In summary, the significant results for gender and family income affirm the hypothesis that males and low-income students are less likely to take dual credit courses. However, for two other underrepresented groups of students, Hispanics and first-generation students, there was no significant mean difference in dual credit course enrollment. Nonetheless, results across all of the demographic sub-groups are useful in two ways. First, the results provide insight into the ways in which different groups of students may (or may not) be building human and academic capital in preparation for college. Second, they provide rich background context for using multivariate statistics to look at the effect of dual credit on college outcomes.

### QUESTION TWO: DUAL CREDIT & GPA

The second research question investigated the effect of dual credit on GPA and hypothesized that students who take dual credit have higher GPAs than students who do not take dual credit. As indicated by literature on student success, a student's ability to persist from year-to-year is critical to successfully completing a degree. With the

understanding that students who are prepared for college are more likely persist, research question two used multivariate statistics to examine GPA as a way to measure academic preparation. The results indicate that dual credit course-taking while in high school does have a positive effect on college GPA. For each additional hour of dual credit taken in high school, freshman college GPA increases by .145 grade points, when controlling for all other factors.

Further examination of the results for GPA provides additional perspective. The three strongest positive predictors of GPA in the model are all academic including: high school rank, SAT, and dual credit (according to standardized beta coefficients). This is a useful finding for considering how one might influence students to increase levels of academic preparation and/or college GPA. Specifically, it is possible for an education institution or an individual student to take steps to help students increase their academic performance (rank and SAT score) or participation (number of dual credit courses). For example, according to the results of the study, a student who increases their SAT score by 114 points (one standard deviation) will have a college GPA that is higher by .114 grade points. Likewise, a three-hour dual credit course can increase college GPA by .435 grade points.

The relationships between GPA and the control variables for race/ethnicity and gender provide yet another perspective. Specifically, the study finds that academic preparation, as measured by GPA, is lower for underrepresented students than their peers. When compared to white students, black and Hispanic students have lower GPAs. And compared to males, females have higher GPAs. Meanwhile, first-generation and low income status is associated with lower GPAs than having higher levels of parent education and family income.

These findings can inform how resources and programs are designed to impact levels of college readiness. For example, underrepresented students tend to have lower college GPAs. However, the high school academic variables – SAT, high school rank, and especially dual credit – are positively associated with GPA. Education institutions, and high schools in particular, can use this information to guide the development of programs and policies that focus on increasing college readiness.

### QUESTION THREE: DUAL CREDIT & GRADUATION

The third research question focused on how dual credit affects the probability of graduation and posits that dual credit students have higher odds of graduating that non-dual credit students. The conclusion of this study is that for each hour of dual credit a student takes, they are 3.9% more likely to graduate from college than non-dual students. Therefore, a three-hour dual credit course increases the probability of graduation by 11.7%, when controlling for all other factors.

The control variable with the most effect on graduation is gender. A female student is 17% more likely to graduate from college than a male student. Meanwhile, white students are more likely to graduate from college than either Hispanic or black students who are respectively 6.8% and 7.8% less likely to graduate. When results for race and gender are examined alongside results for family income and parent education, underrepresented students are less likely to graduate from college than their peers. Both family income and parent education have a positive effect on graduation. However, low-income students are 4.2% less likely to graduate than middle-income students and first generation-students are 4.1% less likely to graduate than students whose parents have an Associate's degree.

Of the three academic characteristics included in the study, dual credit has the highest effect on probability of graduation (11.7%), followed by high school class rank. Students ranked in the top twenty-five percent of their class are 10% more likely to graduate from college than peers in the lower seventy-five percent of the class. The relationship between SAT scores and graduation is small but positive; for each one-standard deviation (114 points) from the median SAT score of 1090, students are 5.7% more likely to graduate from college.

The results for research question three confirm that dual credit course enrollment can positively influence a student's chances of earning a degree, while also providing insight into graduation outcomes for different groups of students. The findings indicate that female students are more likely to graduate and black and Hispanic students are less likely to graduate. These insights are useful for considering which students might benefit from additional academic support structures, including dual credit.

### IMPLICATIONS FOR POLICY

This study finds that underrepresented students tend to have lower GPAs and are less likely to graduate from college than their peers, but that dual credit has a positive effect on both of these outcomes. Dual credit is not fully located in either K-12 or higher education. Instead, it occupies a liminal space within the P-16 pipeline. Therefore, stakeholders who wish to develop supportive policies must understand both the opportunities and the challenges associated with regulating a program that, by design, requires coordination between the K-12 and higher education systems. There are numerous examples in Texas alone, ranging from funding for dual credit and GPAs to rules on the number of courses a college student may drop or the number of hours they may take.

As discussed in Chapter 2, the most supportive policies for funding dual credit allocate funds to both the college and the school district, since both entities are incurring costs. In Texas, a dual credit student is generating "average daily attendance" for the school district and "seat time" for the college. These two methods of allocating education funds are guided by different definitions of attendance, different academic calendars, different funding formulas, and different payout schedules – all for the same student. Thus, a school district and college must work together to understand and align expectations in order to fulfill the requirements and expectations for the two different systems.

GPAs are another example of an area it is important for policymakers to understand that K-12 and higher education differ. Dual credit students generate two separate GPAs when they are enrolled in a dual credit course – one for high school and another for college. If a student receives a low or failing grade in a dual credit course, the grades on the college transcript will remain with them in all future academic endeavors including, but not limited to, eligibility for scholarships and applications to any other institutions of higher education. Therefore, the stakes are high for ensuring that students are prepared to take dual credit and that they have appropriate levels of academic support when they are enrolled in these courses.

A third example of the challenges and opportunities created by dual credit in Texas is the development of state laws and rules regarding both the limits on the number of credit hours taken in higher education and the number of courses a student may drop while enrolled in higher education (known as the "six-drop rule"). Each of these policies was designed to incent students and colleges to save time and money by graduating on time and taking only the number of required college courses. When these policies were first issued by the Texas Legislature, they did not make provisions for dual credit

students. Over time, and with input from multiple stakeholders – including TEA, the Texas Higher Education Coordinating Board, and the Texas Association of Collegiate Registrars and Admissions Officers – exemptions and guidance were issued regarding dual credit. However, arriving at the resolution required collaboration between many K-12 and higher education partners. (A detailed description of the recommendations and process related to the six drop rule is provided by: The Texas Association of Collegiate Registrars and Admissions Officers November, 2007).

State and institutional policies can either promote or limit dual credit, depending upon how they are written and implemented. As described above and in Chapter 2, the Texas Legislature has passed a number of bills that have impacted dual credit. Some have created a supportive environment including allowing high schools and colleges to receive funding for dual credit courses (HB 415, 2003), creating Early College High Schools (SB 1146, 2005), and implementing the College Credit Program, which requires all school districts to offer high school students an opportunity to earn a minimum of 12 college credit hours (HB 1, 2006). While this body of policy has generally been regarded as quite beneficial to dual credit, there are policies which can be improved and new policies will continue to be developed. Thus, I offer the following policy recommendations.

### DEVELOP POLICIES WITH INPUT FROM PRACTITIONERS

In 2011, the Legislature passed a bill that may inadvertently undermine efforts to serve underrepresented students through dual credit. Senate Bill 419 limited higher education institutions from receiving state funding for dual credit physical education courses (SB 419). According to the bill analysis, because all community colleges do not require physical education courses to earn an Associate degree, the courses are not included in the core curriculum for four-year colleges (SB 419 Bill Analysis, 2011). A

memo from the Texas Higher Education Coordinating Board states that there was no exclusion for Early College High Schools (Brown & Stephenson, 2011). As an individual policy act, the effect of this bill is rather limited. However, the decision to limit state-funding for a specific dual credit course, and physical education in particular, does have some additional implications which may have been unintended.

Dual credit courses serve as the foundation upon which Early College High Schools have been built. These schools – which are designed to serve underrepresented students who would not necessarily attend college – enable students to graduate from high school with either an Associate degree or up to 60 college credit hours. This goal is accomplished by offering a small number of dual credit courses beginning in the ninth grade. The majority of ninth graders are not yet college ready, and this is particularly true for underrepresented students. Therefore, the dual credit courses offered to ninth graders require students to take a college placement exam, but do not require a minimum score on math or writing. This finite group of courses, which previously included physical education, is used to introduce students to college rigor and expectations while accommodating for a lack of experience in college-level writing and math. Early College leaders and other proponents for underrepresented students would consider this to be an innovative and productive use of dual credit. However, SB 419 disincentivizes using college-level physical education courses in this way.

This bill provides an example of why it is important for policymakers to have a full understanding of the nuances of dual credit. As previously stated, the scope of SB 419 bill is limited, but it could set a problematic precedent. Following the passage of this bill, the Texas Higher Education Coordinating Board issued a recommendation that only academic dual credit courses should be funded if they are part of the core curriculum, an approved field of study curriculum, or a voluntary statewide transfer compact (THECB,

2012c). While the intent of this recommendation is to decrease time to degree, it does not acknowledge the institution-level complications related to transfer and articulation that students encounter when attempting to obtain credit from four-year institutions for courses (dual credit or otherwise) taken at two-year institutions.

The decision to limit or discontinue funding for dual credit courses on a case-by-case basis without focused attention on all aspects of the program could be problematic. It is important to recognize that the current funding structure both incentivizes and facilitates the current dual credit environment. In addition, dual credit courses may be beneficial in ways that are not currently quantified or documented. Therefore, it is recommended that policymakers fully understand the program in addition to seeking and considering input from practitioners. Otherwise, policies that attempt to address perceived concerns may also remove beneficial support structures for students who are striving to become college ready.

### ALIGN & ENHANCE DATA SYSTEMS

One way to increase the level of knowledge about dual credit is for policymakers and/or state agencies to ensure that appropriate data are being collected and analyzed to improve implementation. Multiple studies have reinforced the need for longitudinal data that includes demographic data and high school academic characteristics, in order to control for prior performance (Bragg, 2006; Bragg et al., 2005; Karp and Jeong, 2008; Lerner and Brand, 2006). This study used data from the Texas Higher Education Coordinating Board that included demographic data, high school rank, and SAT in order to apply statistical controls. Nonetheless, there are ways to improve data systems that would facilitate additional research.

Previous research conducted by Eklund (2009) identified issues around dual credit data in Texas. One issue identified was misreporting of Advanced Placement and concurrent enrollment courses as dual credit courses. Because questions are often raised about the efficacy of dual credit as compared to AP, it is helpful to differentiate between the two types of offerings. A second, larger issue identified in the study was a lack of alignment between K-12 and higher education data. Each of the state agencies collects dual credit data. However, the K-12 agency (TEA) includes only high school outcomes and the postsecondary agency (THECB) focuses primarily on higher education. The delineation is logical based on scope of work and the data that is collected meets the legislative reporting requirements of each agency. However, it does not readily support analysis of dual credit outcomes.

The Texas Higher Education Coordinating Board indicated that in 2012, more specific data on dual credit would be available; this includes course location as well as student grades in dual credit and subsequent college courses (THECB, 2012c). These additional data elements will provide new information in the higher education data. However, there does not currently exist a dataset which intentionally combines K-12 and higher education data elements needed to fully examine the impact of dual credit.

It is recommended that the state agencies jointly develop a state-level dual credit dataset that includes the variables necessary for studying the efficacy of dual credit. The recommended data elements include: high school characteristics (school size, percent economically disadvantaged students); dual credit enrollment and performance (number and type of courses taken, grades); dual credit characteristics (location, academic versus technical, enrollment in an Early College); differentiation of college-level coursework (number and type of Advanced Placement courses taken and grades); high school outcomes (graduation, college enrollment); demographic information (race, gender,

socioeconomic status, financial aid eligibility); college outcomes (GPA, developmental education, persistence, time to degree, graduation). With the exception of enrollment in an Early College, all of these data are currently collected by one or both of the state agencies, but they are not available together. The creation of a dataset that combines these elements would provide the information necessary to gain a full understanding of dual credit and its effect on college outcomes for each of the student populations.

### IMPLICATIONS FOR PRACTICE

This study finds that students who are male, black, Hispanic and/or low-income enroll in dual credit at lower rates than their peers. It is likely that the reasons students do not enroll in dual credit vary both by institution and by individual. However, practitioners can make a concerted effort to ensure that all students have equal opportunity to participate in dual credit. In order to do this, educators must purposefully design and implement their dual credit programs and ensure equal access for all students.

### DEFINE THE PURPOSE OF DUAL CREDIT & SET GOALS

A statewide dual credit study conducted on behalf of the Texas Education Agency found that the majority of decisions about dual credit in Texas are made at the postsecondary level. While 71% of high school respondents reported that decisions are made by the college, 80% of colleges reported that decisions about dual credit are driven by college faculty (AIR, 2011). This is understandable when considering that by definition, dual credit is designed to offer college-level experiences and coursework to high school students. However, one could also make the case that it is important for all dual credit participants in both K-12 and higher education – administrators, teachers, and students – to understand the purpose of the program and have a stake in its success.

At its inception, dual credit was offered only to high-achieving students. Over time, however, dual credit has become a mechanism for supporting middle-performing and at-risk students. With the passage of the College Credit Program in Texas, the state codified expectations that all students (not just those who self-select into advanced courses) would have opportunities to earn college credit. As the number of students participating in dual credit continues to increase, high schools and their partnering colleges should clearly define the purpose and goals of their dual credit programs.

It is recommended that both partners collaborate to develop a clear and agreed-upon definition of the purpose and goals of dual credit. There are a number of collaborative goals that meet the needs of both educational partners. For example, one collaborative goal could be ensuring that all students pass a college placement exam and take a dual credit college success course by the time they graduate from high school. Another goal might be to align all dual credit courses with degree pathways at the partnering community college. A third goal might be to ensure that students earn at least 15 college credit hours (rather than the 12 required by the College Credit Program), because this aligns with performance metrics outlined for community colleges. Finally, another goal might be to increase the number of underrepresented students participating in dual credit.

There are many reasons that it is recommended to define the purpose and set goals for a dual credit program. First and foremost, by defining goals the partners can develop processes that align intentions with actions. Second, the process of outlining goals enables each partner to quantify the benefits of the program to each institution. Third, the goals can help faculty and students understand the expectations and requirements for the program which may, in turn, encourage participation by more students. The purpose is to

enable K-12 and higher education partners to intentionally design dual credit programs to support students.

### MEASURE PROGRESS

Measuring the progress of a dual credit program both ensures that goals are being met and provides information that can be used for program improvement. Both schools and colleges should jointly participate by collecting data that allow for formative analysis of the program. These data elements include: demographic data for students; the number of students who pass college placement exams and when; student enrollment by grade level; course grades; high school graduation; and college enrollment. These data elements provide the information needed to determine who is participating in dual credit and whether or not they are successful. However, administrators should also consider conducting focus groups with current and former dual credit students to identify ways to support dual credit students.

While much of the focus should be on student performance in dual credit courses, data can be also collected and used to benefit institutions. For example, a school district and a college can collaborate to conduct an analysis of dual credit courses. The data collected might include: what courses are offered; who teaches dual credit; and where courses are taught (college campus, high school, or online). This information will allow the partners to determine if there are unmet needs. In addition, it can be used to ensure that the courses offered to students are aligned to academic pathways, transferable to four-year degrees, and relevant to students.

### ENSURE EQUAL ACCESS TO DUAL CREDIT

This study found that students do benefit from participating in dual credit, as reflected in college GPAs and graduation. It also reinforced what other studies have

found, that underrepresented students are not as likely to enroll in dual credit courses. In order to ensure equal access to dual credit, there are a number of areas where administrators can take action to provide student supports, including advising, testing, and funding.

Many students, including but not limited to underrepresented students, may not enroll in dual credit simply because they do not know that it is available or understand how it works. Educators can make concerted efforts to increase the level of knowledge among students through advising. Resources that support advising include developing written materials that clearly explain dual credit and training counselors to provide updated and accurate information to students.

As previously discussed, students who wish to enroll in dual credit courses must meet entrance requirements, which requires advance planning and preparation. Students who do not consider themselves college-bound may not take the necessary college placement exams. Or, they may require additional supports to prepare for the placement exams. Middle and high school teachers can play a significant role in encouraging students to participate in dual credit and helping them understand and meet the various requirements.

Dual credit funding is an area of important consideration for both institutions and individuals. State policy allows districts to charge students for tuition, textbooks, and fees related to dual credit unless they are in an Early College High School (TEA, 2011). This policy, which is determined at the local level, can have an adverse effect on low-income students, who may not have the ability to cover these expenses. School districts and colleges can take measures to ensure that students are not charged, either by covering the costs through institutional funding or by developing scholarship funds.

While these recommendations can benefit all students who are learning to navigate college courses, they are particularly important for underrepresented students. Colleges and school districts can work together to make dual credit accessible to all students.

### IMPLICATIONS FOR THEORY & CONTRIBUTION TO THE FIELD

Human capital theory (Becker, 1993) is useful for examining how the knowledge and skills an individual acquires are based on expected levels of return in the future. This study hypothesizes that high school students who took dual credit in high school will have more successful outcomes on college GPA and graduation than their non-dual credit peers, due to higher levels of knowledge and skill acquired through dual credit. This framework has been widely used in education but not dual credit and it is very useful for understanding dual credit as a mechanism for future payoff. However, it has also been criticized for failing to acknowledge that there are inherent limitations imposed by social and educational contexts as a result of class structure. Critics believe that the theory fails to recognize that upward mobility is limited for some individuals (Bowles & Gintis, 1972; Collins, 1971).

On its own, Human Capital Theory could cause educators to take a deficit-based approach to students who do not take steps to increase their human capital, especially underrepresented students who are less likely to have access to opportunities to proactively build knowledge and skills. To address these limitations, the study used a second framework, Academic Capital Formation (St. John et al., 2011). While this framework has not previously been used to guide dual credit studies, it allows for the development of a conceptual model in which dual credit enables underrepresented students to attain not only academic, but also social knowledge and skills, required to

navigate college. Therefore, Academic Capital Formation acknowledges and addresses the limitations of Human Capital Theory. These two theories, which have not been used together in a dual credit study, provide a framework for conceptualizing and testing the effects of dual credit on college outcomes.

Used together, Human Capital Theory and Academic Capital Formation enable researchers to examine how dual credit is being employed by students who are first-generation college students and those whose parents attended college. In both instances, dual credit appears to serve as a mechanism for navigating high school and college educational systems. The specific types of personal benefits that students accrue may differ based on their existing levels of human capital and their needs regarding academic capital formation. However, it appears that dual credit does have a positive significant effect on college-level outcomes.

As described above, the two theories in this study provide a conceptual model for examining how dual credit is employed by students at different levels of academic preparation and opportunity. By using state-level data from Texas and conducting quantitative research that applies statistical controls, this study contributes to the field in some important ways. Texas is a large state with a growing Hispanic population that is of particular interest nationally because similar demographic changes are expected to occur nationwide. Dual credit enrollments have increased significantly for a number of years, nationwide and particularly in Texas. However, it is only within the past couple of years that the amount of research on dual credit has increased, both as the practice has become more widely-recognized and as datasets with the necessary data elements have become more accessible. Therefore, this study of dual credit in Texas provides information that can inform policy and practice and upon which we may continue to build a dual credit research agenda.

## FUTURE RESEARCH

One of the well-known limitations of dual credit research is the potential existence of unobserved characteristics (such as motivation or family support) that enable high school students to enroll in college-level courses. By definition, dual credit students must meet admission requirements in order to participate in the courses, which introduces selection bias. This study used multivariate regression analysis to address the bias created by academic ability. While quantitative methods cannot address unobserved characteristics, qualitative studies can provide additional contextual information that is inaccessible in quantitative designs (Gubrium & Holstein, 1997; Miles & Huberman, 1994). Therefore, an ideal dual credit study design would combine multivariate regression with qualitative methods, such as interviews or focus groups, to allow researchers to gather information about students' unobserved characteristics. Future studies could also gain deeper insight into selection bias by examining student outcomes using multi-level modeling while controlling for high school characteristics and/or selectivity of the higher education institution.

Another quantitative method that can be used to address the bias inherent to dual credit is regression discontinuity. While its use in dual credit research has been quite limited (Speroni, 2011b; Rodriguez, Hughes & Belfield, 2012) this quasi-experimental method allows researchers to compare outcomes for dual and non-dual students by studying high school students whose college placement exam scores are just below the cutoff score. Regression discontinuity has not been employed to examine data in Texas. This method is useful for examining the impact of policies, such as the recently-implemented changes to the Texas Success Initiative.

Future research could examine the effects of dual credit on college outcomes for transfer students or Early College High School students using Texas data. In addition,

studies could use newly-collected Coordinating Board data elements to examine whether there are differences in student outcomes when dual credit is taught at the high school, on the college campus, or during the summer. In summary, there are many opportunities for future research on dual credit using both statewide and institutional data.

# Conclusion

Dual credit exists within a larger context that continues to grow and change including: college and career readiness, P-16 partnerships – between K-12 and higher education – and increased scrutiny on efficiency and effectiveness in education. As the education landscape continues to transform, the boundaries between high school and college are increasingly tested and changed using strategies such as dual credit.

This study of dual credit in Texas provides a useful set of findings for researchers and practitioners alike. The most important finding from the study is that dual credit positively impacts college outcomes, including both freshman college GPA and degree completion. This conclusion furthers prior research on the effects of rigorous coursework in high school and, specifically, the positive impact of dual credit.

The study examined how dual credit impacts different groups of students, using academic and demographic controls. The results indicate that students who are underrepresented in higher education have lower enrollment in dual credit courses (with the exception of Hispanic students). They also have lower GPAs and a lower probability of graduating from college, when controlling for all other factors. It is helpful to consider the outcomes for underrepresented students alongside the positive outcomes for dual credit students. Together, they suggest that enabling students to increase their levels of human and academic capital – through dual credit – prepares students for success in college.

The affirmation of dual credit as a mechanism for increasing levels of college readiness is useful for both K-12 and postsecondary educators. The efficacy of dual credit is questioned by critics who argue that high school students have limited ability to complete or succeed in college-level courses. However, the results of this study serve as a reminder that resources and opportunities in high school can either inhibit or promote success in the future.

# APPENDIX A

Table A.1: THECB Files Used to Construct Dual Credit Database

| File Name | Title | Description | Number of Records |
|---|---|---|---|
| 00B | Admissions Report | Who applies, who is admitted, and who enrolls at each institution | 3.3 million |
| 00S | Student Schedule Report | Individual courses and grades taken by student at the end of each semester | 12.2 million |
| 001 | Student Report | All students enrolled at an institution on the 12th class day or census date | 27.9 million |
| 002 | Texas Success Initiative Report | Information on student readiness for freshman level coursework, as determined by state tests | 14.6 million |
| 009 | Graduation Report | Degrees conferred in the immediate preceding fiscal year | 1.8 million |
| FADS | Financial Aid Report | Students eligible for financial aid | 6 million |

Table A.2: Correlations Between Study Variables

| | GPA | Graduation | Log Sum Dual | Black | Hispanic | Other | Gender | First Generation | Family Income | Rank | SAT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GPA | 1.00 | | | | | | | | | | |
| Graduation | .3392*** | 1.00 | | | | | | | | | |
| Log Sum Dual | .2652** | .1443* | 1.00 | | | | | | | | |
| Black | -.1796*** | -.1197*** | -.1232*** | 1.00 | | | | | | | |
| Hispanic | -.0710*** | -.0929*** | -.0472*** | -.1902*** | 1.00 | | | | | | |
| Other | .0692*** | .0358*** | -.0452*** | -.1292*** | .1933*** | 1.00 | | | | | |
| Gender | .0815*** | 1472*** | .0600*** | .0586*** | -.0153*** | -.0213*** | 1.00 | | | | |
| Parent Education | .1314*** | .1394*** | -.0044 | -.0848*** | -.3025*** | -.0025 | -.0529*** | 1.00 | | | |
| Family Income | .1382*** | .1510*** | .0289*** | -.2222*** | -.2595*** | -.0674*** | -.0716*** | .0497*** | 1.00 | | |
| Rank | .3368*** | .2513*** | .2168*** | -.1254*** | .0245*** | .0429*** | -.1060*** | -.0158*** | -.0053*** | 1.00 | |
| SAT | .3193*** | .2473*** | .0510*** | -.3407*** | -.2089*** | .1398*** | -.1661 | .3069*** | .3222*** | .3077*** | 1.00 |

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