Curriculum Track And Its Influences On Predicting High School Dropout Likelihood

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ABSTRACT

Dropping out of school is a major concern as high school graduation credentials have been used as an important measurement tool to define post-secondary success. Numerous researchers presented a multitude of factors that predict dropouts at individual and school levels. Curriculum track choice, or high school course-taking sequence, defines students' schooling career and ultimately the post-secondary path that they choose (Plank, DeLuca, & Estacion, 2008). Scholars have debated on various outcomes related to dropouts influenced by various curriculum choices, namely academic, career and technical education (CTE), dual enrollment, and general curriculum. Several argued students following academic tracks are more likely to graduate. Others claim that CTE benefits students who are at-risk and suppresses dropout likelihood (Rumberger & Sun, 2008). New vocationalism or dual enrollment has proven successful at reducing dropout rates.

This study attempted to investigate the influence of curriculum track and CTE program areas on dropout likelihood while controlling for possible individual differences. Analysis was conducted via Hierarchical Generalized Linear Modeling (HGLM) due to the nested data structure of Education Longitudinal Study of 2002 (ELS). Variables included were academic background, academic and career aspiration, school-sponsored activity participation, school minority composition, school average student socio-economic status (SES), school type (private or public), school urbanicity, CTE courses offered at the school, and demographic indicators (gender, race, and SES). Findings reflect higher dropout likelihood among general curriculum

participants than academic and occupational concentrators after controlling for all possible individual differences. Dual concentrators had 0% dropout rate, and therefore comparison with other curriculum tracks was not possible via HGLM analysis. Results suggest substantial importance of academic background, post-secondary education plans, and school-sponsored activity participation in predicting dropout likelihood.

Comparing CTE program areas, Family and Consumer Sciences, Human Services, Public Services, Health and Education (Human Services area) participants were more likely to drop out than other program areas while Technology Education participants were less likely to drop out than Human Services and 2 or more CTE program area participants. Results suggest 9th grade overall GPA and school-sponsored activity participation as substantial predictors of dropout likelihood among occupational concentrators. Variability across schools was insignificant.

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CHAPTER 1

INTRODUCTION

The American High School Dropout Scenario

High school dropouts have taken center stage among most research studies in American education. In most research, the potential consequences of not completing high school are not just a liability to the dropouts themselves, but are also perceived as detrimental to the society as a whole. High school graduation and dropout rate reports concluded that approximately two-thirds of ninth graders nationally graduate four years later (Martin & Halperin, 2006). According to Cox (2009), "At a time when experts predict that about two-thirds of the new jobs will require some education beyond high school (college, work, apprenticeships, or military), nearly a quarter of students drop out of high school without graduating" (p. 6). Heckman and LaFontaine (2007) had a parallel view with Cox (2009) on the American education scenario:

> …it is surprising and disturbing that, at a time when the premium for skills has increased and the return to high school graduation has risen, the high school dropout rate in America is increasing. America is becoming a polarized society. Proportionately more American youth are going to college and graduating than ever before. At the same time, proportionately more are failing to complete high school. (p. 1)

Heckman and LaFontaine also mentioned in their article that the American high school graduation rates had a downward trend in most of the post-1970s period, until 2007.

Interestingly, scholars have been in disagreement on the basics – the U.S. high school dropout statistic. Rumberger (2011) listed three factors that influence the accuracy of dropout

and graduation rate calculations: (a) suitable definition, (b) accurate data, and (c) "an appropriate formula for estimating the defined rate using the selected data" (p. 59). Depending on the data sources, definitions, and methods used, Heckman and LaFontaine (2007) mentioned that "the U.S. graduation rate is estimated to be anywhere from 66 to 88 percent in recent years—an astonishingly wide range for such a basic statistic" (p. 3). Furthermore, they indicated that dropout rates calculated usually exclude those who have earned a General Education Development (GED) Certificate, although GED holders are usually those who have dropped out of school at one point of time during their high school career (p. 3). This distorts the statistic as it escalates the number of high school graduates. In a review of different methodologies of calculating the high school graduation rates, Heckman and LaFontaine concluded that the American high school graduation rate peaked at 80% during the 1970s, and also that GED is one of the main factors that caused an upward bias in the graduation statistics. An increase of approximately 7 to 8% is reported when GED completers are included as high school graduates in calculating graduation rates (p. 28).

Nevertheless, the National Center for Education Statistics (NCES) used a methodology that excluded GED completers in producing most of their high school dropout rate reports. According to its official website (http:// http://nces.ed.gov/), "NCES is the primary federal entity for collecting and analyzing data related to education" (para. 1). Among national datasets administered by NCES are the annual Common Core of Data (CCD), High School and Beyond (HSB), National Education Longitudinal Study of 1988 (NELS:88), and Education Longitudinal Study of 2002 (ELS). Most graduation and dropout studies by NCES are based on these datasets.

In this study, I will be using NCES's ELS 2002 dataset to explore the associations between curriculum track and high school dropout likelihood. Chapman, Laird, Ifill, and

KewalRamani (2011) described four different rates that NCES used in defining high school graduates and dropouts in their reports as follows:

1. Event dropout rate measures the percentage of dropouts among people in a population over a specific period of time (p. 14).
2. Status dropout rate measures "the percentage of individuals in a given age range who are not in school (public or private) and have not earned a high school diploma or an alternative credential" (p. 14).
3. Status completion rate measures "the percentage of individuals in a given age range who are not currently enrolled in high school and who have earned a high school diploma or an alternative credential, irrespective of when or where the credential was earned" (p. 14).
4. Averaged freshmen graduation rate "estimates the proportion of public high school freshmen who graduate with a regular diploma 4 years after starting 9th grade" (p. 14).

These four categories reveal different numbers. For example, approximately 75% who were sophomores in 2002 graduated in 2004, as indicated by NCES's averaged freshmen graduation rate, while status dropout rate in 2004 was established at 10.6% out of 36.5 million youths aged 16 to 24 in the U.S. (Laird, DeBell, & Chapman, 2006). Status dropout rates appear to be lower since they consider those with GED credentials as a non-dropout. In another study, Stillwell (2010) reported that the averaged freshman graduation rate (AFGR) was 74.9% in 2008. This suggests that approximately one-quarter of high school freshman fail to graduate on time. A lot of dropout research uses NCES's graduation and dropout reports as references since they were based on nationally representative datasets. Comparisons with various datasets such as state

level, district level, and school level data were made to derive conclusions on various factors related to dropouts and other high school related issues.

The Editorial Projects in Education (EPE) led by Education Week in 2008 used Cumulative Promotion Index (CPI) method in calculating high school graduation rates. EPE uses the CCD, U.S. Department of Education's annual census of public schools and school districts in the United States, in its analyses. In its report, Editorial Projects in Education (2008) indicated a 71% graduation rate in 2008 among American high school seniors, based on the 2005 high school freshman cohort data.

From the various high school graduation rate reports mentioned in the previous paragraphs, most are on the same track in their indication of alarming figures in high school completion and dropout statistics. They suggest at least one-fifth of American high school students fail to complete a high school diploma, which implies that approximately one in every five youths in America did not possess any high school credentials, suggesting they either took longer to complete, pursued alternative credentials such as GED, or dropped out of school. These alternative outcomes were concluded dependent upon datasets used and calculation methods applied.

The consequences of high school dropouts continue to concern the American public at large. Sum, Khatiwada, and McLaughlin (2009) listed several of the consequences that follow the dropout plague, which include severe unemployment, below poverty household income, formation of teenage and single parenting households, increased institutionalization problems, dependence on social welfare, "negative net fiscal contribution to society" (p. 16), and lower tax revenues for the nation.

A US Census Bureau report related to educational attainments and expected earnings confirms economic disadvantages of high school dropouts as they only average an annual income of US$18,900 whereas high school graduates on the average earn $25,900 (Day & Newberger, 2002). The vast difference signals the importance of earning a high school diploma to be able to achieve better employment outcomes.

Background of the Problem

There are several reasons identified in the research that contribute to the high school dropout phenomenon, and they are very diverse in nature. Among factors constantly reported to predict high school dropout rates were race (Griffin, 2002; Silver, Sanders, & Zarate, 2008), socio-economic status (Christle, Jolivette, & Nelson, 2007), poor academic achievement (Plank, 2001; Silver et al., 2008), and institutional environment (Christle et al., 2007; Knesting, 2008; Silver et al., 2008). Meeker, Edmonson, and Fisher (2008) found that 41 out of 158 study participants indicated pregnancy and parenting as the cause of dropping out of school, 34 of whom were females. Their study also included other reasons for dropping out, namely conflict with school personnel, employment, and frequent moving from state to state. Knesting (2008) agreed with Meeker, Edmonson, and Fisher (2008) on the influences of school personnel and further elaborated on high school environment that either encourages or discourages a student to persist. Besides schooling environment, Fredricks, Blumenfield, and Paris (2004) highlighted disengagement in school as one of the predictors of high school dropout. The factors associated with dropouts discussed above are just a few among a myriad of others. There are factors attached to the individual students themselves, while others closely related with the school environment in which they are located.

Although numerous research studies have been conducted on the causes and remedies of dropouts, very few empirical studies have been done that directly relate to the curriculum itself. The purpose of education, as mentioned by Lee and Ready (2009), generally shifts from developing an individual at the elementary school level, to preparing one for the workforce and citizenship at the secondary school level (p. 136). Due to this "shift" in defining goals of education, there had been many controversies revolving around what should be taught at the secondary school level. Questions constantly debated addressed the things that students should be taught in schools – whether they should standardized or should a menu be available to cater for various needs and levels of the diverse American society. Lee and Ready put forward two controversial questions: (a) "Should all students be exposed to the same academic material, or should curricula reflect students' interests, abilities, and potential adult occupations?" and (b) "Who should make such decisions—parents, schools, or the students themselves?" (p. 136). Both questions remained unanswered, or are in constant debate until today.

Plank, DeLuca, and Estacion (2008) explicitly mentioned the curriculum being a vital part of the school environment, thus possibly making it a contributing factor toward high school persistence:

> "One important aspect of the school environment is the formal curriculum—the set of courses taken by a student. The high school curriculum can be viewed as a socially structured set of opportunities and constraints. An individual course may represent an opportunity for inspired learning, establishing social connections, boredom, or discouragement. The combination of all courses taken throughout a high school career significantly defines a student's place within the social organization of the school and determines, in part, the paths that a student follows after high school." (p. 345-346).

Education in the American society aims to either prepare a high school student for the world of work, or prepare them for college. At the turn of the twentieth century, debates revolved around "whether or not students are best served by a common academic curriculum or by a differentiated curriculum that offers alternatives" (Gray, 2004, p. 129), responding to the needs of an increasing number of students, and of different backgrounds resulting from an influx of immigrants at that time. According to Mayer (2008), school systems in America expanded as a result of "industrialization, the passage of child labor laws, and profound urban growth during the period between 1890 – 1940" (p. 9).

The evolution of school-to-work curriculum took its center stage in the late 1980s, when "students' outcome goals for CTE were expanded from school to work to transition from school to college or work" (Gray, 2004, p. 129). Students wanting to pursue a college career most often take a different curriculum route than their peers who see the workplace as their post-secondary destination. Bottoms (2006) indicated that the Southern Regional Education Board's Commission for Educational Quality had encouraged states to build a firm partnership with career and technical education in 1985, in line with efforts to improve student success in high schools. Through this effort, High Schools That Work were established, and the design of schools in this group provided a rigorous curriculum that caters to students' varied interests.

The education system has been built upon diverse needs of the society, therefore providing high school students with choices that would help them achieve their goals. However, do these different educational paths ensure the society of persistence in high school? Besides having distinct curriculum paths that will route students to either pursue a college career or enter the workplace upon high school graduation, Plank (2001) mentioned, "explicit attempts to combine vocational education with a solid academic grounding have become increasingly

common" (p. 2). He explained that through providing students with a mixture of courses that include both rigorous academic and career education courses, students would have more post-secondary options when they graduate from high school. Plank (2001) went on further to investigate the differences between students of different curriculum tracks in terms of their achievement, post-secondary destinations, and also dropout status. He found that there is a pattern observed between course-taking and probabilities of dropping out of high school in which students who are at-risk tend to have the lowest dropout probability when the ratio between career education and academic courses they have taken is near 1 (p. 17-18).

More recently, Bridgeland, Dilulio, and Balfanz (2009) conducted research on the views of school principals and teachers in their battle against the dropout plague. There were contradictory views among the research participants on curriculum rigor to encourage high school graduation, with 59% of the teachers supporting an alternative curriculum track for students who are not college-bound. This track would have less academic rigor so that at-risk students will be able to graduate. Less than one-third of the participants were in support of having "all students to meet high academic standards, graduate with the skills to do college-level work, and receive extra support if they are struggling" (Bridgeland, Dilulio, & Balfanz, 2009).

Factors influencing students' choice of curriculum track have not been widely discussed in the literature. Oakes (2005) mentioned that students were being tracked based on their academic achievement, teacher and guidance counselor recommendations, and student preference. Research shows that these three factors were indeed evident in student placement in high school courses, with the addition of race/ethnicity and SES being significant predictors of curriculum tracking (Akos, 2007; Lucas, 1999).

As curriculum is the heart of schooling, this factor should be carefully studied in terms of its impact on students and how well it serves the purpose of today's ever-challenging global situations. Other factors such as race, socio-economic background, peer influence, and motivation only explained a certain portion of the dropout phenomenon. One of the most substantial elements that the students are engaged with or are disengaged from in school is the curriculum. Most studies that attempt to investigate the relationship between curriculum track and dropout likelihood would include demographics as control variables, and the association levels were dependent upon factors included in the study. There are very few empirical studies that attempt to investigate the relationship by including factors that research has shown to be related to both curriculum track choice and dropping out.

Problem Statement

Although a myriad of high school dropout predictors have been identified through various research studies, as well as various remedies being recommended to overcome this national problem, the dropout phenomenon continues to be a major threat to the American society as a whole. Since curriculum defines a student's academic career, and ultimately determines his or her success in school, there appears to be a certain magnitude of relationship between curriculum track and high school dropout. Up to this date, very few studies conducted directly associate curriculum track with dropping out of school while controlling for factors that are possibly correlated with both occurrences. Therefore, this study aimed to investigate whether or not choices of curriculum track have a significant association with the likelihood of dropping out among high school students, while controlling for predictors that might influence both curriculum track choice and dropout likelihood.

Significance

As many studies have found, one single variable will not in itself determine a student's decision to complete his or her high school career successfully or to drop out. For most high school students, it takes a combination of multiple factors to instigate the decision to drop out or be persistent. Researchers have also argued that dropping out of school is a long and gradual process, and factors related to this event may be detected early in an individual's schooling career. Nevertheless, there could be means that will distort the long and gradual process of dropping out of school to continue and promote persistence instead. Therefore, the findings from this study will help explain how, and to what degree (if any significant magnitude is detected) curriculum track choice plays a role in the high school dropout phenomenon, after major possible differences between the participants are taken into account. The differences to be accounted for in the study involve previously researched factors that influence curriculum track choices and dropout likelihood. This will inform all parties involved on whether curriculum track choice has a vital part in determining the culmination of a student's high school career.

Research Questions

The following research questions were investigated in this study:

1. To what extent do high school students of various curriculum tracks differ in the likelihood of dropping out of high school, after controlling for major possible individual differences?
2. How do institutional factors related to curriculum track (such as minority composition, level of neighborhood poverty, available funding, and CTE courses offered) associate with the likelihood of students dropping out of high school?

3. How do different career and technical education areas differ in the likelihood of dropping out of high school?

Theoretical Framework

Tinto (1975) developed a model based on the notion that a student's decision to drop out is a gradual process, dependent upon the degree of student's integration with his or her academics and social aspects of the institutional environment. The lower the degree of integration, the more likely a student will drop out of school. Both aspects are pertinent to engagement in a student's schooling experiences, as explained by Finn's (1989) participation-identification theory, which states the importance of a student's "bonding" with school and the absence of "bonding" will lead to behavioral problems, resulting in dropout occurrences. Since curriculum is an integral part of a student's schooling career (Plank, DeLuca, & Estacion, 2008), a student's engagement with academics and the school system is very much related to curriculum track choices that they make.

Methodology

The research questions in this study were investigated using the hierarchical generalized linear model (HGLM) method due to the nested data structure involving students nested within schools. Based on this study's aim in exploring the different roles each curriculum track plays in determining dropout likelihood, outcome variables are categorical, thus HGLM was suggested as an appropriate method of analysis. The HGLM was used to investigate the differences in the likelihood of dropping out of high school among students of different curriculum tracks in different schools. Based on Raudenbush, and Byrk (2002), using the multi-level model in evaluating institutional factors that might have an influence on dropout likelihood is most appropriate to differentiate between within- and between-schools variances, allowing better

estimates in relationships between student variables, curriculum, and institutional factors. This will be further elaborated in the methodology section.

Delimitations

In this study, the ELS dataset was utilized. The participants were delimited to those who participated in the base year survey (sophomore cohort 2002) with valid base year student weights and transcript weights. In order to analyze curriculum tracks, course credits that were earned by the participants were determined from the transcript information obtained in the year 2005, a year prior to the second follow-up survey. Therefore, those without transcript data were excluded from the analysis. In addressing CTE program areas, the participants were delimited to only occupational concentrators who fulfill the requirements as explained in the Definition of Terms section of this chapter.

Limitations

This study identified limitations as described below:

1. This study only included participants with transcript data, thus missing cases might not be uniform throughout the states represented. Therefore, caution must be practiced in generalizing the results as the possibilities of underrepresentation in a few states might occur.
2. Although I have attempted to control major preexisting differences among participants that occur prior to any curriculum track choices in high school, inferences made based on the results were at most the association level without any causal implications since the nature of the data is non-experimental. Confounding major factors that were suspected to have associations with curriculum track choices, high school dropout episodes, and high school persistence were identified as thoroughly as possible from the ELS dataset. I have

exercised as much control as possible in treating these covariates. However, this control may not be as exhaustive as other methodologies such as the propensity score matching methods. The quality of the results obtained rest on how much covariates control was exercised.

Definition of Terms

Curriculum Track

The focus of this study was to investigate the association between different high school curriculum tracks and the likelihood of dropping out of school. Therefore, defining the different curriculum tracks available is crucial for the purposes of this study. The following definitions were derived from Plank's (2001) study, using the National Education Longitudinal Study 1988 (NELS:88), which has similar definitions for curriculum tracks. The NCES uses Carnegie units in the calculation of course credits accrual, and the definition of a Carnegie units is "equal to a course taken every day, one period per day, for a full school year" (Ingles et al., 2007).

An *academic concentrator* is defined as having completed four Carnegie units of English and three Carnegie units each of mathematics, science, and social studies. A Carnegie unit is equivalent to completing a course that meets one period per day for an entire school year, of the equivalent instructional time (120 hours of classroom instruction) (Levesque, Wun, & Green, 2010). In most states, academic concentrators follow a specified curriculum track that enables students to prepare for college.

An *occupational concentrator* is defined to have completed at least three Carnegie units in a single Specific Labor Market Preparation (SLMP) career and technical education program area.

A *dual concentrator* fulfills both the requirements of an academic and an occupational completer. In several states, a dual concentrator underwent a dual-enrollment program that allows them to earn college credits through the school's partnership with a local community college.

A *general track participant* fulfills neither of the specified requirements for academic, occupational, or dual completer. Most likely, the students were working toward a standard high school diploma with minimum credit completion requirements.

High School Dropouts

In this study, the high school dropout of interest is a student who does not fulfill the requirements to "graduate high school through a normal process of matriculation, seat time, and formal graduation" (Heckman & LaFontaine, 2008, p. 6). This is based on Heckman and LaFontaine's definition of a high school graduate that refers to "those who receive a traditional high school diploma from an accredited high school program" (p. 6), as opposed to a high school completer, "who either graduated high school or obtained an alternative credential (e.g., GED)" (p. 6). This definition was selected because the main predictor of dropout in this study was curriculum track choices, and excluding students who obtained alternative credentials besides a high school diploma in the dropout definition would not be reflective of the curriculum tracks that students follow during their high school careers. Therefore, participants of this study were considered as dropouts if they did not earn a high school diploma or exited high school prior to completing high school graduation requirements.

School-sponsored activities

School-sponsored activities encompass school-sponsored extracurricular and co-curricular activities as defined by the ELS dataset. These activities were used as a student-level

predictor in this study as a proxy to the social aspect of schooling that is essential in predicting dropout likelihood based on Tinto's (1975) model.

Summary

As high school persistence is key to the economic and social growth in America, high school dropouts can be considered a threat to the society. Scholars, researchers, government bodies, and tertiary institutions have attempted to determine the causes of this phenomenon and many have offered remedies. However, there have been very few studies that addressed the high school curriculum in direct association with high school dropout. This study attempted to explain if curriculum track is a significant element that does have a role in determining the success or failure in a student's high school career. Studying curriculum track in isolation is not possible, given the fact that there are many contributing factors towards curriculum track alone that will be further explained in the next chapter of this study. Besides that, other variables that define individual study participants also contribute as an influence in determining the chances of students staying in or dropping out of high school. Ultimately, this study concluded if curriculum track has a significant influence on high school persistence in America, after major individual differences have been considered.

CHAPTER TWO

LITERATURE REVIEW

Chapter two of this dissertation is a result of an extensive review of literature related to high school dropout scenarios and curriculum structure in the United States. First, high school dropout scenarios including definitions and predicting factors both at the student and school level are discussed. The second part of the literature review encompasses high school curriculum tracks, discussing the history of curriculum tracks in the United States, factors that influence student choices, and how these different tracks might influence dropout likelihood. Finally, the theoretical and conceptual frameworks that guide this study based on the review of literature are proposed and discussed.

High School Dropout Scenarios in the United States

Gray (2004) mentioned in his article that besides strengthening democracy, the American "public education's role is arguably to promote individual opportunity and economic growth" (p.130). Interestingly, Balfanz and Legters (2004) argued that the American high school system intersects with numerous critical social and economic issues. In a report released by NCES in 2011, approximately 3 million youths between the ages of 16 and 24 in the United States were not enrolled in high school, and possessed no high school diploma or any other alternative credentials in October 2009 (Chapman, Laird, Ifill, & KewalRamani, 2011). In addition to that, Orfield (2004) expressed that approximately two-thirds of high school students in America who entered ninth grade graduate with regular diplomas four years later, and this only includes half of all Blacks, Latinos, and Native Americans. Many research studies have concluded that dropouts

generally tend to be unemployed, incarcerated, unmarried or divorced, and living in poverty (Orfield, 2004; Sum, Khatiwada, & McLaughlin, 2009). Tyler and Lofstrom (2009) further added that dropouts are costly to society because they are most likely to not succeed in the labor market, thus contributing less in terms of tax revenues. Additionally, taxpayers have to bear the expenditure on public assistance and healthcare for dropouts who are impoverished and dropouts "are greatly overrepresented in U.S. prisons" (Tyler & Lofstrom, 2009, p.88).

Defining High School Dropouts

In line with the provisions of the No Child Left Behind Act of 2001, Swanson (2004) defined high school graduates as those who received "regular standards-based" high school diplomas, and those who obtained other "nondiploma credentials" such as certificates of attendance or General Education Development (GED) were not considered graduates (p.18). This definition was also used by Heckman and LaFontaine (2008) in their study, in which they referred to high school graduates as those who received a traditional high school diploma from an accredited high school program. The NCES graduation rate report based on the Common Core of Data (CCD) for the 2007/08 school year defined a high school graduate as someone who has been awarded a high school diploma or any alternative diploma recognizing higher academic achievements, and can be referred to as someone who had met or exceeded the "coursework and performance standards for high school completion" (Stillwell, 2010, p.1). Whether students who complete the GED program should be considered as high school graduates or dropouts has been constantly debated. However, according to Tyler and Lofstrom (2009), those with a GED did not have equally favorable outcomes in the workforce or in post-secondary education. Therefore, the definition used consistently by NCES in calculating graduation rates excludes GED completers, and they are categorized as dropouts. From all of the definitions described above, this study will

define high schools graduates as those who completed high school with a high school diploma, and those without a diploma will be considered as dropouts.

In the review of literature, there is a vast range of high school dropout statistics reported by various researchers. Kaufman (2004) expressed that these differences are due to high dependence on data source as the different rates obtained were based upon different populations and different methodologies. He further added that large sampling errors were generally present in rates obtained through survey methods. Bracy (2009) discussed that discrepancies between different dropout rate reports exist due to the definition of factors that are involved in the calculation process. In one example, he explained the inaccuracies of using ninth grade enrollment in the calculation because of a phenomenon called the "ninth grade bulge" (p. 610), reflecting that a significant percentage of ninth grade students in a given year comprises students who were retained or were transferred from private schools. Thus, this causes the ninth grade enrollment to be significantly higher than its corresponding eighth grade enrollment in the previous year.

Factors Associated with High School Dropouts

In addressing the dropout crisis, it is crucial to identify its causes that can be related to individual students, their families, their communities in which they live, and also their institutions (Rumberger, 2004). Rumberger noted that this process of dropout cause identification is highly complicated. Bridgeland (2010) further elaborated based upon the findings of his research that dropping out of school "was not a sudden act but a slow process of disengagement from school" (p.103). I acknowledge the multitude of factors that are related to dropping out of school from the extensive amount of literature available, but the ones identified for this study are suspected to have confounding effects with curriculum track choices.

Academic prior achievement and risk factors. The most common predictor of high school success found in a large number of research studies is prior achievement. On the other side of the argument, academic risk factors are associated with dropouts, such as grade retention, absenteeism, and poor achievement during middle school (Allensworth et al., 2009; Jimerson, 2001; Plank, 2001; Rumberger & Sun, 2008; Silver, Saunders, & Zarate, 2008). I acknowledge from an extensive literature review that there are multiple aspects associated with academic prior achievement and risk factors that influence high school dropouts. However, due to the unavailability of information related to ELS participants' academic records prior to high school except grade retention, I will only focus on grade retention that will be used as an academic risk factor proxy in this study.

Students' being old for their grade due to grade retention is an academic risk indicator that has been discussed by several researchers to be among the important predictors of high school dropouts. Grade retention or repetition occurs when students begin a new school year in the same grade level as they were in the previous school year (Brophy, 2006). Jimerson's (2001) meta-analysis of grade retention research between the years 1989 and 1999 suggested students who were retained in school had higher tendency to drop out of high school as compared to their counterparts. More recent research supports Jimerson's synthesis, in which according to Allensworth (2004), students who were retained in elementary schools most likely did not complete high school with a standard diploma, and obtained alternative diplomas or GED. This resulted from being older than average when they entered high school, and several were at least 16 years old when they enrolled in ninth grade. More in-depth research on the time retention occurs and its association with dropping out was conducted by Jacob and Lefgren (2009), in

which they found students who were retained at eighth grade were more likely to be high school dropouts than their peers who were retained at sixth grade.

In general, grade retention tends to increase the likelihood of dropping out of high school after controlling for other possible differences among students (Goldschmidt & Wang, 1999; Fine & Davis, 2003; Lee & Burkam, 2000; Silver et al., 2008; Stearns, Moller, Blau, & Potochnick, 2007). However, Jimerson, Anderson, and Whipple (2002) reinforced that no single predictor can solely determine the odds of dropping out, and that includes grade retention. Nevertheless, they suggested that when a student is retained, it is more likely that events leading to dropping out of school such as disengagement, absenteeism, and low self-esteem take their course, resulting in unsuccessful high school completion. Goldschmidt and Wang (1999) also suggested poor academic achievement being the cause of grade retention, which in itself is a predictor of high school dropouts.

Academic and career aspirations. In a research report, Bridgeland, Dilulio, and Balfanz (2009) indicated that teachers perceived students who were high school dropouts as those who had weak academic motivation. On the other hand, when Bridgeland, DiIulio, and Morison (2006) conducted a study among high school dropouts aged 16 through 25, they found that career aspirations were present among these dropouts. However, "a series of circumstances in students' lives and an inadequate response from schools, communities, and the students themselves" (Bridgeland, 2010, p. 102) had caused these students to drop out of high school.

Griffin (2002) found in his study that academic achievement seemed to be of less importance among Black and Hispanic students in their decision to withdraw from school when compared with their White and Asian counterparts. This "academic disidentification" phenomenon explains detachment from academics resulting from the development of

"subcultures that illustrate cultural opposition toward academics" which then leads to an increased likelihood of dropping out of high school among Blacks and Hispanics (Griffin, 2002, p.74). Furthermore, African American male students "reserve greatest respect" for their peers who "exhibit sexual and athletic prowess" as opposed to those with high academic achievement (Hubbard, 1999).

Demographic factors. In the large body of high school dropout literature, several demographic factors were most often included in studies, namely gender, race/ethnicity, and socio-economic status (SES). However, the impacts for these demographic variables tend to be reduced or amplified, depending upon other factors incorporated in the analyses. Dalton, Glennie, and Ingels (2009) reported several characteristics of high school dropouts based on the Education Longitudinal Study 2002 (ELS) dataset. According to Dalton et al., males had higher dropout rates than females (7% versus 6%), students from the lowest SES quartile had the highest dropout rate of 48%, Hispanic students had the highest dropout rate of 11% as compared to other races, and students from public schools dropped out at higher rates than those from Catholic and other private schools.

Another study investigating Los Angeles Unified School District's high school graduation predictors by Silver, Saunders, and Zarate (2008) agreed with Dalton et al.'s findings with regard to gender and race, in which females have higher odds of completing high school compared to males, and students who are Black or Hispanic have lower odds of graduating than their White and Asian counterparts. In another report, Black males in inner city schools had a 50% dropout rate (Mishel & Roy, 2006). On the contrary, Goldschmidt and Wang (1999) concluded that African American students were less likely to drop out of high school than

Whites after controlling for student characteristics including misbehavior, grade retention, employment, reading and writing achievement, and English proficiency.

Among the most common predictors of high school dropouts reported in research would be low SES background (Lee & Burkam, 2000; Meeker, Edmonson, & Fisher, 2008; Rumberger & Palardy, 2005; Silver et al., 2008). Meeker et al.(2008) reported that high school dropouts indicated financial problems in the family as one of the reasons they had to quit school. They had to secure jobs to support their family, thus making it an obstacle to attend and finish school. However, Silver et al. (2008) found that students who were eligible for free or reduced price lunches had higher odds of graduating high school than others of the same gender, ethnicity, and English proficiency.

School-sponsored activity participation. Engagement with the school environment has been identified to have an influence on dropout decisions among high school students. Tinto (1975) identified that participation in school-related extracurricular and co-curricular activities (school-sponsored activities) was one dimension of exerting a connection with the educational institution that students are in, and the level of involvement does influence the decision to retain. Knifsend and Graham (2005) found in their study that there existed a curvilinear relationship between school-sponsored activities involvement with academic performance and school engagement. According to their study, "participating in a moderate number of different types of activities (i.e., two activity domains) may be most optimal for helping adolescents to feel connected to their school and to do well academically" (p. 88). From another perspective, Fredricks and Eccles (2010) stated that the threshold model suggested that too high involvement levels with school-sponsored activities might reduce the level of involvement with others in the school and reduce time for academic-related work.

School factors. Balfanz (2009) mentioned that "In a third or more of U.S. high schools nearly everyone graduates; in 15 percent of schools graduation is not the norm, and graduation rates can be 50 percent or lower" (p. 24). Christle, Jolivette, and Nelson (2007) expressed their concerns from their research findings on school characteristics associated with dropouts that students' readiness to enter post-secondary institutions, workforce, or any other post-high school destinations is highly dependent upon "what happens within the school walls" (p. 333). Several school factors associated with high school dropouts have been identified from the review of literature. Among the factors were type of school, schools' average academic achievement, minority composition, school neighborhood's poverty level, and available funding.

A large body of empirical research concluded that Catholic and other private schools tend to produce lower dropout rates than public schools (Evans & Schwab, 1995; Rumberger & Palardy, 2005; Rumberger & Thomas, 2000). On the contrary, several studies found that there were no significant differences in student achievement and dropout rates between public and private schools after taking into account other student factors (Carbanaro & Gamoran, 2002).

Research pointed out that high schools with higher dropout rates tend to enroll more students from minority races and ethnicities (Balfanz & Legters, 2004; Christle et al., 2007; Silver et al.; 2008). Silver et al.'s findings suggested that students who attended schools with larger percentages of White and Asian students were more likely to graduate from high school than those who attended "racially isolated" schools. Balfanz and Legters specified that nearly half of the nation's African American students, almost 40% of Latino students, and 11% of White students attend such schools. Furthermore, they indicated that a major difference between schools with high minority composition that had higher graduations rates compared with the ones that had lower graduation rates was the amount of funding the schools received. Balfanz

(2009) explained that there is some sort of interconnection between racial segregation and poverty due to "the abandonment of the public school system, particularly at the secondary level, by middle- and upper-income families in some central cities and Southern counties" (p. 20). He also mentioned that in these localities, public schools enroll mainly minorities, and private school students were disproportionately Whites.

The disparities in how much investment is allocated per student play a role in determining dropout tendencies. Balfanz (2009) found from his comparison among U.S. schools in the 50 wealthiest and 50 poorest communities in 2006 that students in the wealthiest communities graduated in a timely fashion, in contrast with only two-thirds of their peers in the poorest communities. This finding is explained by the significantly lower teacher-to-student ratios in the wealthiest communities, reflecting higher per pupil expenditure. In fact, Balfanz and Legters (2005) reported schools with high minority compositions in New York metropolitan area suburbs with higher graduation rates, indicating stronger promoting power, received an average per pupil expenditure of $13,245 compared to $8,725 received by New York City schools with weaker promoting powers (lower graduation rates).

Interestingly, the issues that influence high school dropouts discussed above might also carry weight in determining students' curriculum track choices in school. Therefore, it is interesting to explore the confounding relationship that these predictors have with dropout and curriculum track choices to determine if policies and best practices can be improved upon to achieve better graduation rates among the American public high schools, thus addressing the dropout phenomenon more effectively.

The U.S. High School Curriculum

Oakes (1985) outlined a history of the curriculum tracking and ability-grouping emergence in the U.S. education system. She mentioned that the influx of immigrants into America in the early twentieth century caused a "population explosion" (p. 19) had stirred a secondary schooling crisis. The college preparatory education system that was designed to cater to a historically predominant Anglo-Saxon society no longer seemed to address the needs of youth from very diverse backgrounds due to the overwhelming increase in immigrants. As a result, the comprehensive high school was the solution agreed upon – "a new secondary school that promised something for everyone" (Oakes, 1985, p. 21). However, the nineteenth century notion of equality in content and instruction was replaced by "curriculum differentiation – tracking and ability grouping – with markedly different learnings for what were seen as markedly different groups of students" (Oakes, 1985, p. 21).

A majority of schools in the United States used some form of curriculum tracking by the middle of the twentieth century, and today most of the schools in America practice curriculum tracking for its students (Futrell & Gomez; 2008; Hallinan, 2004).

Curriculum Tracking/Choice/Placement

Curriculum tracking has been defined as the categorization of students based on their academic abilities or other measures of cognitive intelligence into distinct groups for the purposes of teaching and learning in public education systems (Akos, 2007; LeTendre, Hofer, & Simizu, 2003; Oakes, 2005; Wheelock, 1992). Wheelock (1992) further elaborated that after the distinction is made, different curricula were designed to provide students with the particular set of curriculum and instruction deemed appropriate for their perceived levels of ability as identified through formal or informal methods of assessments.

Curriculum differentiation in the United States "primarily occurs within comprehensive secondary schools" (Kelly & Price, 2011, p. 3). According to Archbald and Keleher (2008), students entering secondary schools (from sixth grade onwards) will usually receive their course placements for the next school year. Each school district has its own placement policies, and the variation from district to district is inevitable due to the large number of students and courses available. According to Oakes (2005), there are three kinds of information being considered when a student is tracked, namely "scores on standardized tests, teacher and counselor recommendations (including grades), and students' and their parents' choices" (p. 9). Archbald and Keleher (2008) further added, "Teachers' recommendations are largely decisive, but parents and guidance counselors are also involved in varying ways; moreover, there is inevitable subjectivity in these placement decisions" (p. 35).

In the large body of literature concerning curriculum tracks, most comprehensive public high schools offer four distinct tracks, namely academic or college preparatory track, dual enrollment, career and technical education (CTE), and general track (Fletcher, 2009). Rumberger and Sun (2008) explained that "college track" is the most rigorous curriculum with access to college-level courses, while general track typically prepares students for two-year or less colleges, and remedial tracks prepare students for high school graduation. They also explained that CTE courses were designed to prepare students for employment directly after high school and also for advanced vocational or technical courses in community colleges.

The academic or college preparatory track comprises high level academic and college level courses while students following the general track most often enroll in lower level academic courses to fulfill minimum graduation requirements. CTE offers sequences of career and vocational courses that students have to complete in order to be considered a CTE

concentrator. According to the U.S. Department of Education website, the Carl D. Perkins Career and Technical Education Act, the legislation that authorizes federal funding to be channeled to CTE programs, defines CTE as follows:

> …organized educational programs offering a sequence of courses directly related to preparing individuals for paid or unpaid employment in current or emerging occupations requiring other than a baccalaureate or advanced degree. Programs include competency-based applied learning, which contributes to an individual's academic knowledge, higher-order reasoning, problem solving skills, and the occupational-specific skills necessary for economic independence as a productive and contributing member of society. (p. 1)

The idea of integrating workplace skills or vocational education in the school system was propagated by John Dewey and Charles Prosser in the early twentieth century through their pragmatic approach toward education. According to Gordon (2008), Prosser's idea of vocational education was to prepare individuals for the workforce and aimed at those who are uninterested in academics so that they would be able to gain skills necessary for the workplace. Dewey, on the other hand, believed in democracy in education that entitles everyone to equal educational access, hence he opposed the idea of separate vocational and academic programs but supported the integration of vocational and academic content (Herrick, 1996). Dewey's idea is transcendental in the growth of vocational education or CTE. In the 1980s, vocational education's aim shifted from preparing students for the workplace to preparing students for both the workplace and college (Gray, 2004). Following this shift, many high schools have adopted the vocational and academic integration ideas into their curriculum through programs like career academies, programs of study, and tech prep. This shift is also known as "new vocationalism" (Lewis & Cheng, 2006). These programs fall under the dual enrollment curriculum track for the

purposes of this study. Dual enrollment involves students enrolling in both college level and CTE courses, in which the relationship between academics and the workplace are emphasized in everyday learning (Maxwell & Rubin, 2002). Among the most successful high schools that offer dual enrollment curriculum are those in the High Schools that Work (HSTW) program. The HSTW initiative began in 1985 to improve student achievement through curriculum rigor by combining high-level academic content and career/technical skills (Bottoms, 2006). The following is Bottom's description of the HSTW program:

> *HSTW* was founded on the premise that many students can learn academic skills best through applied learning strategies, which combine academics with practice and real-world training. Career/technical education must offer students a coherent sequence of vocational and academic courses, along with career classes that use academics to teach skills that students will need for the workplace. Many students need academic courses that include practical and career related examples that show why they need to learn certain skills. Bringing rigorous academics together with useful career/technical learning is the heart of *HSTW*. (p. 3)

Factors Related to Curriculum Tracking/Choice/Placement

Academic prior achievement and risk factors. Test scores on standardized tests conducted in the school system are most often used as an indicator of student achievement in the process of curriculum tracking (Oakes, 2005). Students who were high achievers academically in schools, measured by their grade point average (GPA), were most likely to follow college preparatory or academic tracks (Akos, 2007). Moreover, Oakes (2005) had observed vocational tracks to cater to students of lower academic abilities, and this finding was supported by Akos (2007) who conducted a study among North Carolina middle school students. He indicated the

tendency of special education students to choose the occupational track while gifted students tended to participate in the college preparatory track. In addition to that, Futrell and Gomez (2008) mentioned that tracking based on academic ability led to assignment of students into academic, general, or CTE tracks, and most of the time, students who were deemed unsuitable to advance to four-year colleges would be tracked to learn vocational or technical trades. Lucas (1999) found that the role of prior achievement in college prep course placements makes a difference in racial advantage, in which a Black student was more likely than a White student to be in college prep track when two students were of the same gender, social status, with the same test scores, and equal graduation requirements.

From a different perspective, the NAVE 2004 report indicated that CTE courses are predominantly elective courses and that students have a choice to participate in them (Silverberg et al., 2004). Lewis and Cheng (2006) supported this notion based on their study of 655 high school principals across the U.S. in which the principals indicated student choice as the most important criteria in CTE course placement. Nevertheless, student choice was not the only criteria being valued in the decision. Other factors being considered included "students' special learning needs, parental requests, and guidance counselor recommendations" (p. 91), which reflect the significance of students' academic levels in track placements (Lewis & Cheng, 2006).

Academic and career aspirations. Post-secondary options available to students are most often dictated by curriculum track choices available in high schools (Akos, 2007). Oakes (2005) found that students' educational plans for the future were highly related to the track level they were in at school. According to Oakes, students who were in the higher tracks "had substantially higher educational aspirations than the other students" while students at the lower track levels had very low expectations toward their educational future (p.143). Rojewski and Kim (2003)

indicated in their research findings that students employed immediately after high school were three times more likely to follow an occupational track as compared to their peers who pursued post-secondary education. These "work-bound" youths were reported to indicate a moderate to low level of occupational and academic aspirations as opposed to their "college-bound" counterparts who scored higher on both aspiration scales. Additionally, Ainsworth and Roscigno (2005) reported that students with higher educational expectations were most unlikely to enroll in vocational courses.

Demographic factors. Generally, a few common demographic predictors that influence curriculum track choices were identified from the review of literature, namely gender, race/ethnicity, and SES. These demographic indicators are also commonly found to have relationship with dropout likelihood in previous research.

Several studies found that SES was a factor that exhibited differences in curriculum track choices. Lucas (1999) indicated the association between higher social status and the likelihood of students having higher placements in curriculum tracks. Rojewski and Kim (2003) found that students from the highest SES quartile were four times more likely to enroll in post-secondary education than those in the lower quartiles, and Akos (2007) reported that significantly lower number of students who were eligible for free or reduced price lunches chose to follow the college/university standard course of study. Ainsworth and Roscigno (2005) indicated in their findings that students from high SES families took fewer units of courses in agricultural, blue collar (construction, demolition, building trade, and manufacturing), and low wage service (retail trade, personal services, and entertainment and recreation) sectors.

In terms of gender, research indicated that more female students were following the college/university standard course of study as compared to male students, suggesting higher

academic aspirations among females (Akos, 2007; Buchmann & Dalton, 2002; Trusty & Niles, 2004).

School factors. Ainsworth and Roscigno (2005) indicated from their findings that schools in rural areas were more likely to offer vocational courses. Lewis and Cheng (2006) found in their study that the percentage of students receiving free or reduced price lunches was a strong indicator of vocational course offerings in schools. They reported schools with a high percentage of students receiving subsidized lunches tend to offer vocational education as a dominant curriculum track, compared to schools in more affluent localities.

In terms of vocational education course offerings, Oakes (2005) reported that schools with predominantly white students offered more business courses in their vocational track than schools with high percentage of minority students. However, Oakes did not include SES in her comparison, therefore she speculated that SES might be more associated with the distribution of vocational courses offered as compared to racial composition. The 2004 National Assessment of Vocational Education (NAVE) report indicated that predominantly minority schools in high poverty areas were less likely to adopt dual enrollment programs and college credit courses as part of their curriculum offerings (Silverberg et al., 2004). Regarding school types, Lucas (1999) found no net differences between public and private schools when it came to curriculum track choices among students, but the difference was observed between urban, rural, and suburban schools.

Curriculum Tracking and Dropout Likelihood

In 1983, the Nation at Risk report impacted a lot of policies in the American public education system when it described the current public high school system at that time as “a sea of mediocrity” (Goldberg & Harvey, 1983). There were views that academic rigor at the high

school level was insufficient to produce a workforce with skills needed in the industry, and some even argued that skills needed for the workforce are the same as for entering college (Allensworth, Nomi, Montgomery, & Lee, 2009). Subsequently, many studies were carried out to determine whether curriculum rigor or tracking served the needs for a higher quality workforce and to better prepare students for life after secondary schools. In Rumberger and Sun's (2008) review of empirical research related to course-taking and dropout rates, they found eight out of 15 analyses concluded that there was a lower dropout risk among students who were in academic or college preparatory tracks. Conversely, Allensworth et al. (2009) found that enrolling all students regardless of their academic prior achievement and risk factors in college preparatory courses did not reduce the already high dropout rate in Chicago. In fact, they found an increase in absenteeism among students at the average and high ability levels after the implementation of Chicago's "college prep for all" policy.

CTE, formerly known as vocational education, has been a source of debate related to its effectiveness to prepare students for post-secondary life. According to the U.S. Department of Education (2002), CTE aims to prepare "individuals for the bulk of America's jobs" as a large percentage of jobs available in 1996 required post-high school credentials, most commonly at the community college level, while only approximately 20% of the jobs required four-year college degrees. There were views that stated students with no interest of going to college or who are not prepared to go through the rigors of college courses as being the primary targets of CTE (Castellano, Sundell, & Overman, 2010), as the academic courses that students have to take are usually low-track classes (Oakes, 2005). Mupinga and Livesay (2004) also mentioned in their article that CTE is intended to prepare students for working life and is perceived to be associated with blue-collar jobs such as plumbing, construction, and auto mechanics. Rumberger (2011)

expressed the views of educators that CTE is a means to help suppress dropout likelihood through providing "more relevant curriculum that would prepare them for future employment" (p.22). In short, proponents of CTE argued that CTE is vital in ensuring the needs of diverse learners are met and in helping reduce dropout events in high school (Plank, DeLuca, & Estacion, 2005). On the other hand, an NCES report claimed that students who follow the CTE track had lower mathematics skills than their peers who followed the academic or general curriculum tracks (Planty, Bozick, & Ingels, 2006). Nevertheless, Stern, Dayton, and Raby (2010) argued that most studies were constrained by selection bias as one of the main reasons for their findings since students were not randomly assigned to the specific curriculum tracks.

In addition to these views, many agree that the combination of academic and CTE courses do tend to reduce the likelihood of dropping out among high school students (Plank, 2001; Plank, DeLuca, & Estacion, 2005). According to What Works Clearinghouse (2008), "career academies, focus schools, and curricula that permit students to choose majors seek to ensure that students gain relevant career and technical skills in high school without sacrificing the academic preparation that is necessary for college" (p. 35). Additionally, several researchers concluded that career academies promote student pursuit towards college education at the same level as students in academic or college prep track (Maxwell &Rubin, 2002; Stern, Rayton, & Raby; 2010).

One report suggested a school factor related to curriculum track influencing dropout likelihood. Lee and Burkam (2000) reported lower dropout rates among schools that offer curricula composed mainly of academic courses.

CTE Program Areas and Dropout Likelihood

To date, there is very limited research conducted to explore the relationship between different CTE program areas and dropout likelihood. According to Bradby and Hudson (2007), the U.S. Department of Education's Office of Vocational and Adult Education originally developed 16 career clusters and are currently supported by the National Association of State Directors of Career Technical Education Consortium (p. iii). National Association of State Directors of Career Technical Education's website (http://www.careerclusters.org/) stated that the National Career Clusters™ Framework organizes more than 79 career pathways into 16 career clusters to help students navigate through their career interests and is also used as a tool to design and develop curriculum. According to the website, the 16 career clusters are:

- Agriculture, Food & Natural Resources
- Architectural and Construction Technologies
- Arts & Communications Technologies
- Business Management & Administration
- Education and Training
- Finance
- Government and Public Administration
- Health Science
- Hospitality & Tourism
- Human Services
- Information Technology
- Law, Public Safety & Security
- Manufacturing Technologies

- Marketing, Sales & Service
- Science, Engineering & Mathematics
- Transportation, Distribution & Logistics

Out of the 50 states, 10 (Alaska, Arizona, Florida, Kansas, New Hampshire, Oklahoma, South Carolina, Texas, Washington, and Wyoming) utilized the 16 career clusters to define their CTE program areas, and the other 40 states defined their own program areas or career pathways in structuring their CTE programs. The complete program area list can be found in Appendix A. Each program area would have its own list of course requirements for a student to be endorsed as a concentrator in that specific area.

For the purposes of this study, I have identified 6 common program areas that were used in different states to define sequence of courses in CTE or for students to navigate through their career pathways. The 6 areas are as follows:

1. Agriculture, Food, and Natural Resources Education
2. Business, Marketing, Information Technology, and Computer Science
3. Family and Consumer Sciences, Human Services, Public Services, Health Sciences, and Education
4. General Career Development and Work Experience
5. Technology Education
6. Trade and Industrial Education

Table 2.1 reflects how the 6 CTE program areas used in this study relate to the 16 career clusters defined by the U.S. Department of Education's Office of Vocational and Adult Education and also seven CTE program areas upon which CTE student organizations (CTSO) were built upon (i.e., Agricultural Education, Business and Information Technology, Family and Consumer

Sciences, Marketing Education, Technology Education, Health and Medical Sciences, and Trade and Industrial Education). As there were multiple ways of defining CTE program areas found in the literature, it is not an easy task to determine the absolute grouping for the courses that students undertake to be certified in a particular area. As such, I have grouped the courses based on the most common areas found in the 50 different states, and linked them closely to the 7 CTE program areas based on CTSO as well as the career clusters. Note that for General Career Development and Work Experience area, there are no specific program areas based on CTSO or career clusters. This particular program area addressed students who completed 3 or more Carnegie units in cooperative education or off-campus vocational training, regardless of program area, as defined by the ELS dataset.

Table 2.1

CTE Program Areas Grouping

CTE program areas used in this study	CTE program areas based on CTSO	US Department of Education's career clusters
Agriculture, Food, and Natural Resources Education	• Agricultural Education	• Agriculture, Food, and Natural Resources
Business, Marketing, Information Technology, and Computer Science	• Business and Information Technology • Marketing Education	• Business Management & Administration • Finance • Information Technology • Marketing, Sales & Service
Family and Consumer Sciences, Human Services, Public Services, Health Sciences, and Education	• Family and Consumer Sciences • Health and Medical Sciences	• Education and Training • Government and Public Administration • Health Science • Hospitality & Tourism • Human Services • Law, Public Safety & Security
General Career Development and Work Experience	• None	• None
Technology Education	• Technology Education	• Arts & Communications Technologies • Science, Engineering & Mathematics
Trade and Industrial Education	• Trade and Industrial Education	• Architectural and Construction Technologies • Manufacturing Technologies • Transportation, Distribution & Logistics

In relation to dropout likelihood among the different program areas within CTE, Ainsworth and Roscigno (2005) found that students who participated in vocational courses preparing for blue-collar occupations (construction, demolition, building trade, and manufacturing) at the high school level were more likely to drop out, but participation service sector vocational courses (retail trade, personal services, and entertainment and recreation) had no significant effect on dropout likelihood. As there is very limited literature with regard to dropouts within CTE program areas, this study will attempt to explore this issue and investigate whether there are significant differences between program areas and the likelihood of dropping out among students.

Theoretical Framework

Researchers commonly tie dropout studies to engagement theories such as Finn's (1989) participation-identification model of school withdrawal. Rumberger and Larson (1998) provided an engagement model with two distinct components, social and academic, that relate to academic adjustment. These two theories conceive the notion that school engagement is an evolution of engagement process over time that will eventually lead to success in high school careers or the decision to drop out.

In this study, the focus was on curriculum as a central indicator of dropout likelihood, while controlling for individual and school level predictors. As such, it required a broader theoretical framework that might explain the complexity of factors involved in the dropout decision as curriculum track choice is influenced by several characteristics discussed from the literature review. Tinto (1975) developed a mediation model based upon factors that relate to persistence decisions and how student interaction with academics and the social system contributes to dropout events. This integration evolves over time, and the degree to which

students are integrated with academic and social aspects of the schooling system will eventually determine their exit patterns. In other words, the dropout process "can be viewed as a longitudinal process of interactions between the individual and the academic and social systems" (p. 94) of the institution in which the student is located. Tinto explained that the level of integration greatly depends on the attributes that students enter the high school system with, and this set of attributes comprises demographic factors, academic prior achievement, and aspirations for their future. Archambault, Janosz, Fallu, and Pagani (2009) further elaborated on Tinto's theory that "individual commitments to specific academic goals directly influence involvement in school-related tasks and activities"(p. 652), which is related to the curriculum track choices each student makes. Based on their academic and career aspirations, students follow specific paths to achieve their set goals, and thus influence the level of engagement with academic elements attached to their curriculum choices. In addition, the school factors such as institutional goals and environment also play a role in a student's integration with the school's social system that also depicts a major influence on student decisions concerning their schooling career.

Conceptual Framework

The conceptual framework that guides this research is built upon Tinto's (1975) framework, illustrated in Figure 2.1. In addition to demographic predictors (gender, race/ethnicity, and SES), I incorporated academic prior achievement and risk factors, academic and career aspirations, as well as school-sponsored activity participation at the student level predictor. I have also included school level predictors related to dropout likelihood among high school students based on the ELS dataset. In line with Tinto's model that reflects interaction between students with their academics and social schema at school, this study will also explore the confounding role that each predictor plays on curriculum choice and dropout likelihood. The

student-level predictors, namely academic prior achievement and risk factors and academic and career aspirations, and school-level predictors have been discussed in this review of literature to influence both curriculum choice and dropout likelihood.

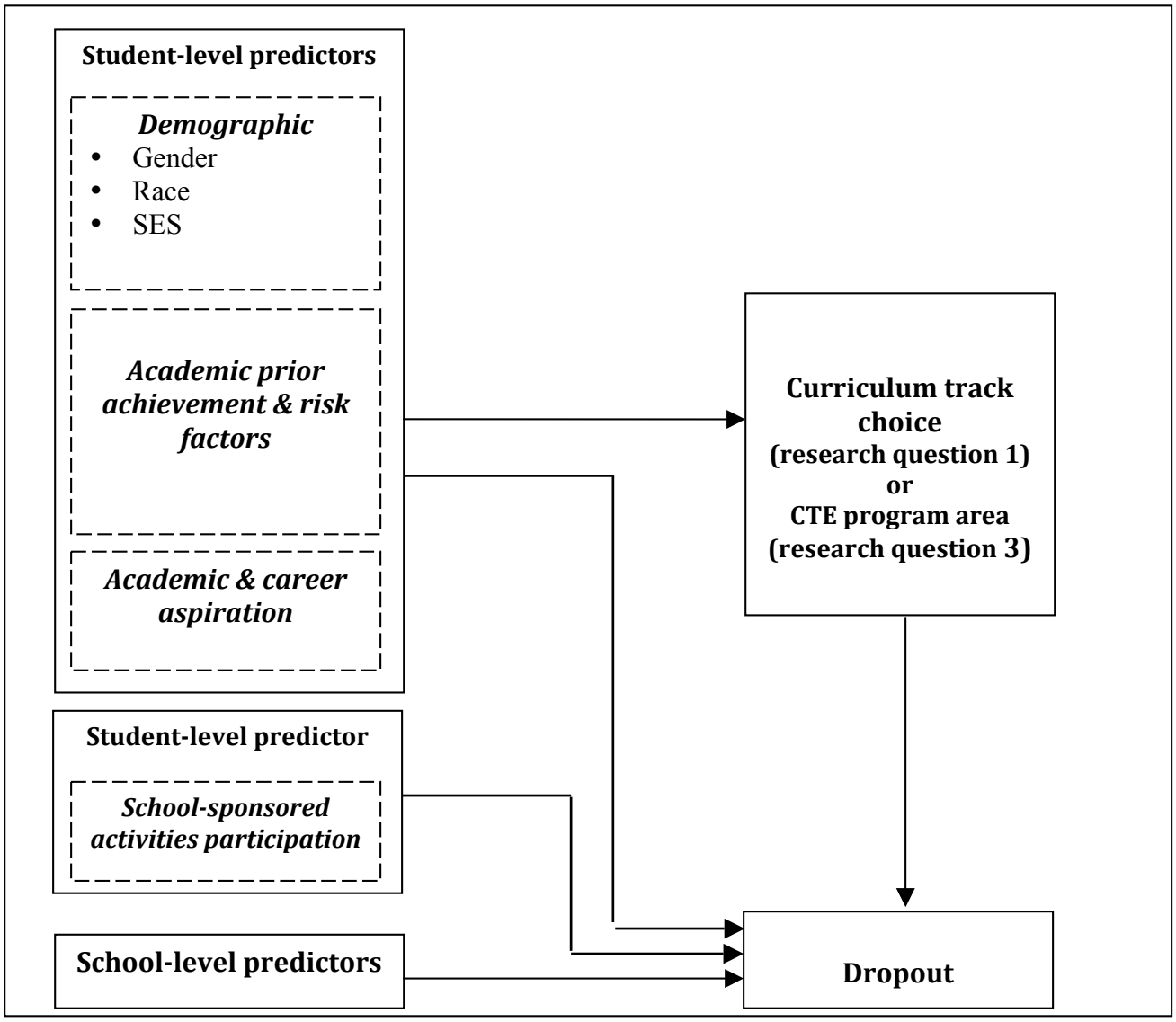

Figure 2.1. **Conceptual Framework**. This framework is used in this study as a guide for building HGLM models.

Summary

This chapter presented the review of literature related to the U.S. high school dropout scenario, and included a discussion of factors that are associated with dropping out of high

school to gain an overview of the phenomenon that guide the direction of this study. As the main variable of interest, the body of literature related to high school curriculum track in the U.S. was also reviewed. Variables that are associated with both track choices and dropouts were found, namely (a) academic prior achievement and risk factors, (b) academic and career aspirations, (c) school-sponsored activity participation, (d) demographic factors, and (d) school factors. The theoretical framework by Tinto (1975) and conceptual framework that guided this study were also discussed.

CHAPTER 3

METHODOLOGY

What students learn in high school is heavily defined by the curriculum track choices that they make. The main focus of this study is to investigate whether or not choices of curriculum track have a significant association with the likelihood of dropping out among high school students through investigating the following research questions:

4. To what extent do high school students of various curriculum tracks differ in the likelihood of dropping out of high school, after controlling for major possible individual differences?
5. How do school factors related to curriculum track (such as minority composition, level of neighborhood poverty, available funding, and CTE courses offered) associate with the likelihood of students dropping out of high school?
6. How do different career and technical education areas differ in the likelihood of dropping out of high school?

This chapter explains the dataset, methodology, analysis plan, and scope and limitations that are involved in this study.

Data

The data used for this study is the Education Longitudinal Study of 2002 (ELS), administered by the National Center for Education Statistics (NCES) of the U.S. Department of Education. It is one of the latest studies that provide data related to students' high school experiences and their paths beyond. According to the ELS website

(http://nces.ed.gov/surveys/els2002/), the survey was "designed to monitor the transition of a national sample of young people as they progress from tenth grade through high school and on to postsecondary education and/or the world of work" (NCES, n.d.). The ELS study follows nationally representative student cohort who were high school sophomores in the year 2002, and followed them all through their high school careers, post-secondary careers, as well as employment. In 2004, the study was augmented so that the sample would be nationally representative of 2004 high school seniors.

The ELS study currently has data available for its base year (BY) survey (2002), first (F1) follow-up (2004), and second (F2) follow-up (2006). It gathers information from students, teachers, and also participating high schools in the base year and first follow up studies. The base year study collected information related to student achievement, attitude, and involvement in high school so far, as well as other experiences in school. Participants were then surveyed again in 2004, which was the first follow up study, to gather information on their academic achievement gains, and high school completion status. Participants' high school transcript information was collected in Spring 2005. In 2006, the second follow up was conducted on the same participants, collecting information with regard to their post-secondary statuses: college application and enrollment, employment, living arrangements, and family construct. The third follow up is planned to be in 2012, approximately 8 years out of high school, to study post-secondary attainment, employment outcomes, and living conditions. According to NCES, it is hoped "that later outcomes, such as their persistence and attainment in higher education, or their transition into the labor market, can be understood in terms of their earlier aspirations, achievement, and high school experiences" (NCES, n.d.).

Analysis Plan

Sampling and Weighting

The subsample for this study was ELS participants who were sophomores in the 2002 base year survey (G10COHRT = 1), based on the following selection criteria:

1. Had non-zero base year survey student weight (BYSTUWT ≠ 0).
2. Had non-zero second follow-up transcript weight (F2QTSCWT ≠ 0).
3. Had no missing data for all the variables included in the analysis, except for if they were ever held back a grade in school (BYP46 and F1N11). This is due to the high non-response rate in the original ELS dataset as the information was from parental surveys. The non-respondents for ever held back a grade will be treated as a valid category (dMissHeldBack) in the HGLM model.

The total number of participants after the selection criteria was employed is n = 11,932. Since curriculum track is part of on-going decision-making processes that start at the beginning of a student's high school career, including participants who have participated as sophomores at the beginning of the study will reflect the tracking decisions more thoroughly. Courses taken by participants that define their curriculum track and their high school exit points were determined by the transcript data which was collected in 2005, a year before the second follow-up study was conducted. Dropping out of high school is a "cumulative process" (Christle, Jolivette, & Nelson, 2007, p. 334) and therefore capturing most of the high school experiences that build upon high school persistence decision will help suggest actions that can be taken to reduce dropout episodes. The subsample generated dropped a substantive number of observations in ELS. Nevertheless, as recommended by NCES, a weighted analysis was performed on all of the regression-based techniques in this study as the transcript weight used will mirror the subsample

to the demographic of United States' tenth graders of 2002 cohort, and that the group is a diverse population comprising individuals from different backgrounds in the United States (Cratty & Wirt, 2011, email communication).

The ELS sample design involved stratification, the disproportionate sampling of certain strata, and multistage probability sampling (Bersudskaya & Chen, 2011, p. 3). Therefore, various weighting schemes have been formulated "to compensate for unequal probabilities of selection and to adjust for the fact that not all individuals selected into the sample actually participated" (NCES, 2007, p. 135). Since ELS is a nationally-representative dataset, analysis utilizing the provided raw sample weights will reflect the results onto the entire population of 2002 high school sophomores in the United States. However, the provided raw sample weights caused SPSS to treat the artificially large sample size as the size of the population, resulting in inaccurate results and standard errors will be underestimated as the nested data structure of ELS is ignored (Stimpson, Janosik, & Miyazaki, 2010, p. 39).

To overcome the problems that may arise by using raw weights that are available in the dataset, normalized weights (or also known as relative weights) were used (Thomas, Heck, & Bauer, 2005). The normalized weights were derived through dividing the raw weight provided in the dataset by the raw weight's mean. Through applying normalized weights, an effective sample size is obtained that reflects the representativeness of the study's population. Particularly, this study used the second follow-up transcript weight (F2QTSCWT) as the raw weight in performing all analyses. This is due to the fact that the high school dropout status information is available during the second follow-up and a dropout event might not have occurred during the first follow-up for some participants as they might have prolonged their high school completion beyond the end of the first follow-up study.

Variables

Dependent variable. In the hierarchical generalized linear modeling (HGLM) models, the dependent variable is based on the F2HSSTAT in the original ELS dataset to determine the likelihood of dropping out of school among survey participants. F2HSSTAT indicates a student's high school completion status during the second follow up survey in 2006. F2HSSTAT identifies if the student completes high school at any point of time in the study period or the status that each student is in during the second follow up survey in 2006. The categories are whether a student graduated from high school, received a certificate of attendance, received or was working toward a GED or other equivalency, was still enrolled in high school, or had neither graduated nor pursued GED or other equivalency (NCES, n.d.).

For the purposes of this study, based on the definition of high school dropouts that only includes students with a high school diploma as high school graduates, F2HSSTAT's five categories was collapsed to two, making the variable a binary one. I have renamed the outcome variable as HSDO (high school dropout status). Students who complete high school with a traditional high school diploma or are still in school in the year 2006 (during the second follow up survey) were considered as non-dropouts, while others were considered as dropouts.

Curriculum track. The main purpose of this study is to investigate whether or not high school curriculum track choices have significant impact on high school persistence. The ELS database denotes the F1RTRCC variable as the curriculum track followed by each student, based on transcript information. This variable indicates whether a student is an "academic concentrator," "occupational concentrator," "academic and occupational concentrator," or "other". An "academic and occupational" concentrator was identified as a dual concentrator and

"other" was identified as a general track participant in this study. NCES defines the curriculum tracks as follows:

> "An academic curriculum concentration includes a minimum of four credits of English; one credit of mathematics higher than algebra II and any two other credits in math; one science credit higher than general biology and any two other credits in science; one credit of social studies in U.S. or world history and any two other credits in social studies; and two credits in a single foreign language. An occupational curriculum concentration includes at least three credits in one specific labor market preparation area, such as agriculture, business, marketing, healthcare, protective services, trade and industrial, technology, food service, child care, and personal and other services programs. Those meeting both the criteria of an academic and occupational curriculum concentration are classified as academic and occupational concentration. Those following a general curriculum meet the criteria of neither an academic nor an occupational concentration." (Planty, Bozick, Ingels, & Wirt, 2007, p. 8)

To answer research question 3, "How do different career and technical education program areas profile in the likelihood of dropping out of high school?", students in the occupational track will be the subsample. Their CTE program area concentration was identified from the number of credits obtained for the courses that they took in a Single Labour Market Preparation (SLMP) area, available from transcript data.

Curriculum track choice indicators. In addition to demographic variables, indicators related to curriculum track choices identified are academic prior achievement and risk factors, as well as academic and career aspiration, and these were included as control variables to evaluate the impacts of curriculum choice on dropout likelihood. In various dropout studies from 1983 to

2007, as reviewed by Rumberger and Sun (2008), these factors were identified as dropout predictors as well as the factors that influence curriculum choice and therefore suspected to be confounding variables influencing both curriculum track choice and dropout likelihood in this study.

Academic prior achievement and risk factors. Several research studies indicate academic prior achievement and risk factors as important indicators of high school curriculum track choice or course placements and are also factors related to high school dropouts (Oakes, 1985; Suh & Suh, 2007). Elaborated extensively in chapter 2, grade retention was found to be a major indicator of dropout likelihood. For the purposes of this study, variables BYP46 and F1N11 that indicated whether a student was ever held back a grade was used as grade retention proxy. A composite categorical variable, HELDBACK, was derived from the BYP46 and F1N11, indicating whether a student was held back at least a grade, never held back, or were non-respondents. The non-respondent category was maintained in the analysis due to its high non-response rate as the variables were obtained from parental survey, and not transcript data.

In terms of academic prior achievement, grade point average (GPA) of students at ninth grade and whether students completed credit hours in Algebra 1, were used as proxies. Using ninth grade academic achievement information is in line with academic measure indicators that might affect curriculum track choices as these measurements most likely occur prior to the track assignments.

Academic and career aspiration. Based on an extensive literature review on aspirations and academic achievement, this study included academic and career aspiration proxies as a covariate of control, which may predict choice of curriculum track and high school dropout

likelihood (Suh & Suh, 2006). The variables included were how far in school students think they will get (BYSTEXP), and students' projection of their occupation at age thirty (BYOCC30).

School factors. The results of various research studies report that institutional factors such as a school's minority composition, schools in high poverty neighborhoods, school's location (urban, suburban, or rural), and available funding are the most common predictors associated with weak promoting powers; and therefore, contributing to high school drop-out rates (Balfanz & Legters, 2004). As such, they will be included as level two predictors in this study. Another school variable related to curriculum tracking included in the study was whether schools offer CTE courses. From literature, catholic and other private schools tend to produce lower dropout rates than public schools (Evans & Schwab, 1995; Rumberger & Thomas, 2000; Rumberger & Palardy, 2005). Hence, school type were included in this study to investigate whether public or private schools have an effect on high school dropout likelihood after controlling for factors related to curriculum tracking.

School-sponsored activity participation. Based on Tinto's (1975) model, engagement with the school has a significant influence on retention. School engagement is visible through two dimensions; engagement with the academic system or engagement with the social system. To represent student engagement with the school's social system, participation in extracurricular and co-curricular activities (school-sponsored activities) has been discussed by previous literature. Several studies agree with this notion in which students who were involved in school-sponsored activities tend to have a higher likelihood of staying in school (Davalos, Chavez, & Guordiola, 1999; Mahoney & Cairns, 1997) and promotes greater sense of belonging and positive academic outcomes (Knifsend & Graham, 2005). As such, this variable was obtained from variables BYS42 (school-sponsored activity participation at base year) and F1S27 (school-

sponsored activity participation at first follow-up) in the original dataset and included in this study as a dichotomous predictor, coded as "1" if a student participated in any school-sponsored activity and "0" if none at all.

Demographic factors. Based on previous literature, there are several demographic traits related to curriculum track choice and high school dropout. The demographic variables are gender, race/ethinicty, and socio-economic status (SES). On gender differences, Akos (2007) discussed the tendency of female students to choose college preparatory courses as opposed to males, and a study by Chappell (2011) revealed male students' higher grade retention likelihood during their schooling career that lead to a higher tendency of dropping out. Rumberger and Sun (2008) mentioned that socio-economic factors were reported frequently in dropout research between the years 1983 to 2007 in which students who come from low SES families were more likely to drop out of school. In relation to curriculum track choices, Akos (2007) mentioned that students who received free and reduced lunch were more likely to follow an occupational curriculum while Bishop and Mane (2005) noted students from higher income families tend to take less vocational-type courses and more rigorous academic courses in high school. Concerning race/ethnicity profiles, Mahoney and Merritt (1993) reported higher tendency of white students to follow a college preparatory curriculum as opposed to their African-American counterparts, while an NCES report by Chapman, Laird, and KewalRamani (2010) noted that Black and Hispanic students were more likely to drop out of high school as compared to their white counterparts. Nevertheless, Rumberger and Sun (2008) indicated that demographic factors' influence on high school dropout events are dependent upon other factors included in the studies. Therefore, these three demographic indicators were included in the study at the student level model based on previous research.

From the description of variables presented above, the independent variables were categorized into two, namely student level and school level predictors. Table 3.1 summarizes all the independent variables that were used in this study.

Table 3.1

Summary of Independent Variables

Level	Variable name	Description
Student	Curriculum track	Curriculum track followed by students as indicated in the transcript data (academic, dual, occupational, general)
	CTE program area	CTE program area concentration that an occupational track student completes
	9^{th} grade GPA	GPA for all ninth grade courses
	Took Algebra 1	If a student has taken any Algebra 1 credit courses
	Held back	If a student was ever held back K-12
	Post-secondary aspiration	Student's post-secondary educational aspirations
	Career aspiration	Student's career aspirations
	Extra/Co-curricular	If a student participated in school-sponsored activities
	Gender	Student's gender
	Race/Ethnicity	Student's ethnicity
	SES	Student's socioeconomic status background
School	Non-Asian minority	School's percentage of non-Asian minority race/ethnicities
	School average SES	School's indication of student SES composition
	School type	Whether a school is public or private
	School urbanicity	Whether a school is located in the urban, suburban, or rural area
	CTE courses offered	Whether CTE courses are offered in schools

Methodology

To better understand the ELS dataset, preliminary descriptive analyses were performed on the major predictor (curriculum track choices) and outcome (high school dropout) variables to study the distribution of the data. Results from the preliminary descriptive analyses are reported in this chapter and were used to determine the most suitable methodology used to arrive at the final results and conclusions. From the results obtained, more detailed descriptive analyses were performed on all predictor variables and the HGLM methodology was found to be most fit in explaining their relationships with dropout likelihood.

Preliminary descriptive analyses. For research question 1 involving curriculum track choice as the main predictor, the distribution of students in each curriculum track, and the percentages of students who graduated from, dropped out of, or were still enrolled in high school were investigated. Students who did not graduate from high school, but obtained or were pursuing a GED we classified as non-graduates as they did not meet the requirements of a high school graduate based on the definition explained in chapter 1 of this study. The analyses performed were weighted using normalized weights, determined from the second follow-up transcript cross-sectional weight (F2QTSCWT) variable. Results show that a majority of high school students (60.4%) followed the general track, 22.4% followed the academic track, 14.3% followed the occupational track, and 2.9% were in the dual track. In the high school completion status analysis, 89.9% high school students who were sophomores in 2002 graduated from high school within the ELS study period, while 9.2% dropped out. Less than 1% of the 2002 high school sophomores were still in school in 2006. The results are shown in Table 3.2 and Table 3.3.

Table 3.2

High School Curriculum Track Distribution from ELS

	Frequency	Percent	Valid Percent	Cumulative Percent
General	7208	60.4	60.4	60.4
Academic	2668	22.4	22.4	82.8
Occupational	1708	14.3	14.3	97.1
Dual	348	2.9	2.9	100.0
Total	11932	100.0	100.0	

Note: Normalized weights were used in this analysis.

Table 3.3

High School Completion Status in 2006 from ELS

	Frequency	Percent	Valid Percent	Cumulative Percent
HS graduate	10727	89.9	89.9	89.9
Not HS graduate	1100	9.2	9.2	99.1
Still enrolled	105	.9	.9	100.0
Total	11932	100.0	100.0	

Note: Normalized weights were used in this analysis.

Preliminary investigation was then performed to explore student outcomes in 2006 that reflect the differences between curriculum track choices and high school completion status. This investigation was done to define the dichotomous value assignments to the dependent variable, HSDO (high school dropout status), based on ELS's F2HSSTAT variable that originally had five categories. A contingency table is produced to describe the number of students who were high school graduates, dropouts, and still enrolled in high schools in 2006.

From the results obtained in Table 3.4, academic track had 99.9% and dual track had 100% of their students graduated from high school. 94.3% of students who followed the

occupational track graduated from high school, a higher graduation percentage as compared to 86.1% among those who followed the general track. Looking at the number of dropouts (including GED pursuers and completers), general track had the highest percentage of students falling into this category (13.9%), followed by occupational track with 5.7% dropouts. Academic track only had 0.1% dropout percentage.

Table 3.4

High School Completion Status in 2006 by Curriculum Track

			HS Dropout		
			Not Dropout	Dropout	Total
HS curriculum track	General	Count	6208	1000	7208
		% within track	86.1%	13.9%	100.0%
		% within HS Dropout	57.3%	90.8%	60.4%
	Academic	Count	2664	4	2668
		% within track	99.9%	.1%	100.0%
		% within HS Dropout	24.6%	.4%	22.4%
	Occupational	Count	1612	97	1709
		% within track	94.3%	5.7%	100.0%
		% within HS Dropout	14.9%	8.8%	14.3%
	Dual	Count	348	0	348
		% within track	100.0%	.0%	100.0%
		% within HS Dropout	3.2%	.0%	2.9%
Total		Count	10832	1101	11933
		% within track	90.8%	9.2%	100.0%
		% within HS Dropout	100.0%	100.0%	100.0%

Note: Normalized weights were used in this analysis. Number of cases is rounded due to weighting.

Results from the preliminary descriptive analyses produced in Tables 3.2 to 3.4 show that students who followed the dual track had no dropouts in 2006. Due to this fact, the HGLM proposed might not be a suitable method if dual tracked students were included in the model as its logit would produce a value of infinity. The most apparent patterns observed were for occupational and general tracks, and variation within these two tracks might offer substantive

insights in explaining this phenomenon. Of course, the preliminary descriptive analyses were conducted without controlling for student and school level predictors. There could be several similar characteristics (i.e., demographic, academic prior achievement and risk factors, academic and career aspirations, school-sponsored activities participation) and school factors that are attached to occupational and general-tracked students, and also characteristics that define academic and dual-tracked students as presented in the review of literature. In line with Tinto's (1975) model, the decision to dropout is dependent upon the level of student integration with academics and social aspects, and curriculum might be an important indicator in explaining the degree of integration. Further investigation via descriptive methods such as chi-square test of association and analysis of variance (ANOVA) were performed in order to determine if academic and dual-tracked students will be included in the final HGLM model to compare the four curriculum tracks with dropout likelihood.

For research question 3 that addressed the differences in dropout likelihood among different CTE program area concentrations, the participants were subsampled to include only occupational concentrators (n = 1,515). To perform the subsampling, weights were removed from the full dataset that includes all participants (n = 11,932) and the total number of unweighted participants who were occupational concentrators is n = 1,515. The normalized weight for the occupational concentrator subgroup was recalculated based on the new sample size through dividing the second follow-up transcript weight (F2QTSCWT) by its new mean.

CTE program areas were identified based on the common program areas, career clusters, or career pathways adopted by all 50 states in the United States. In answering research question 3, I have categorized the CTE program areas into 6 most common areas adopted by the 50 states, with an additional 7th area category that combines two or more of the areas defined (2 or more

areas). The 6 program areas are agriculture, food, and natural resources education (agriculture area); business, marketing, information technology, and computer science (business area); family and consumer sciences (FCS), human services, public services, health science, and education (human services area); trade and industrial area; technology education area; and general career development and work experience (career development area). Concentrators for the specified program areas were determined by the number of Carnegie units earned in course categories defined by ELS. This is shown in Table 3.5 on page 59.

Table 3.6 on page 60 reflected the descriptive analyses on the concentrator distribution of all the CTE program area defined for the purposes of this study. The highest number of concentrators was in the trade and industrial program area (392), followed by business, marketing, information technology, and computer science area (326).

Table 3.5

CTE Program Area Categories

CTE Program Area	Description
Agriculture, Food, Natural Resources Education (Agriculture area)	Students who completed 3 Carnegie units or more in agricultural sciences, agribusiness and agricultural production, and renewable natural resources
Business, Marketing, Information Technology, and Computer Science (Business area)	Students who completed 3 Carnegie units or more in one of the following course categories: a. business and management, and business and office b. marketing and distribution c. computer and information sciences
FCS, Human Services, Public Services, Health Science, and Education (Human services area)	Students who completed 3 Carnegie units or more in one of the following course categories: a. consumer/personal/miscellaneous services b. education c. library and archival sciences, parks and recreation, protective services and public affairs d. allied health and health sciences
General Career Development and Work Experience (Career development area)	Students who completed 3 Carnegie units or more in one of the following course categories: a. special education (vocational career preparatory and exploration) b. basic skills (cooperative education and off-campus vocational technical training)
Technology Education	Students who completed 3 Carnegie units or more in one of the following course categories: a. engineering, engineering-related technologies, and sciences technologies b. communications, communication technologies, and visual and performing arts
Trade and Industrial Education	Students who completed 3 Carnegie units or more in industrial arts, construction trades, mechanics and repairers, precision production, transportation and material moving, and architecture and environmental design
Combination of 2 or more areas	Students who completed 3 Carnegie units or more in two or more program areas, combined

Note 1. Program Area categories are based on common program areas adopted by the 50 states. Complete categories adopted by states can be found in Appendix A of this document.
Note 2. Courses categorized under each program area are based on ELS handbook's Appendix D: Course Content Lists for Subject Area and Composite Variables.

Table 3.6

CTE Program Area Concentrators

CTE Program Area	Frequency	Percent
Trade and Industrial Education	423	27.9
Business, Marketing, Information Technology, and Computer Science	304	20.1
Technology Education	290	19.1
Combination of 2 or more areas	152	10.0
General Career Development & Work Experience	139	9.2
Agriculture, Food, Natural Resources Education	112	7.4
FCS, Human Services, Public Services, Health, & Education	94	6.2
Total	1515	100.0

Note: Normalized weights were recalculated based on the new subsample and were used in this analysis.

Further investigation was performed on each CTE program area's dropout rate. Table 3.7 shows the number of dropouts versus non-dropouts for each CTE program area. Based on Table 3.7 on page 61, human services area had the highest dropout rate of 9.6%, while technology education area had the lowest dropout rate of 1.7%. There appears to be a variation in the dropout rate among the program areas, and further investigation was performed to determine is the difference is significant after controlling for all other possible covariates in this study.

Detailed descriptive analysis on the dependent variable HSDO, curriculum track, and all independent variables both at the student and school levels were performed to explore the associations that each independent variable has with likelihood of dropping out and also curriculum track choices. The research questions in this study were then investigated using the hierarchical generalized linear model (HGLM) method.

Table 3.7

CTE Program Area and High School Dropout (Weighted analysis)

		HS Dropout		Total
		Not Dropout	Dropout	
Agriculture, Food, Natural Resources Education	Count	107	5	112
	% within Program Area	95.5%	4.5%	100.0%
	% within HS Dropout	7.5%	5.9%	7.4%
Business, Marketing, Info Tech & Computer Science	Count	288	16	304
	% within Program Area	94.7%	5.3%	100.0%
	% within HS Dropout	20.2%	18.8%	20.1%
FCS, Human Services, Public Services, Health, & Education	Count	85	9	94
	% within Program Area	90.4%	9.6%	100.0%
	% within HS Dropout	5.9%	10.6%	6.2%
General Career Development and Work Experience	Count	133	6	139
	% within Program Area	95.7%	4.3%	100.0%
	% within HS Dropout	9.3%	7.1%	9.2%
Technology Education	Count	285	5	290
	% within Program Area	98.3%	1.7%	100.0%
	% within HS Dropout	19.9%	5.9%	19.2%
Trade and Industrial	Count	392	31	423
	% within Program Area	92.7%	7.3%	100.0%
	% within HS Dropout	27.4%	36.5%	27.9%
Combination of 2 or more areas	Count	139	13	152
	% within Program Area	91.4%	8.6%	100.0%
	% within HS Dropout	9.7%	15.3%	10.0%
Total	Count	1429	85	1514
	% within Program Area	94.4%	5.6%	100.0%
	% within HS Dropout	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 6) = 16.678$, $p<0.05$

Hierarchical Generalized Linear Model (HGLM). The data design of ELS involves a nested data structure, in which students are nested within schools. Given the nested data structure and categorical outcome variable, HGLM was used to investigate the influence of curriculum track on likelihood of dropping out of high school among high school students. Major possible

covariates at the student level such as demographics, academic prior achievement and risk factors, and academic and career aspirations, school-sponsored activity participation, and also variables at the school level such as school type, geographic location, courses offered, and funding, will be included in the analyses as the explanatory variables.

The dependent variable in this study was identified to be the high school dropout status, HSDO, which was derived from ELS's high school completion status in 2006 variable (F2HSSTAT). As explained previously, F2HSSTAT has five categories (graduated high school, received a certificate of attendance, received or working towards GED or other equivalency, still enrolled in high school, and neither graduated nor pursued GED or other equivalency). In the first chapter, I have defined a high school dropout to be a student who did not earn a high school diploma, or exited high school prior to completing high school graduation requirements. As such, the F2HSSTAT's five categories were collapsed into two and the variable HSDO (high school dropout status) has value assignment as follows:

1. "Not a dropout" (HSDO = 0) combined the original categories of "graduated high school" and "still enrolled in high school."
2. "Dropout" (HSDO = 1) combined the original categories of "received a certificate of attendance," "received or working towards GED or other equivalency," and "neither graduated nor pursued GED or other equivalency."

The two categories used are in line with Heckman and LaFontaine's (2008) definition of high school graduates used in this study (students who received high school diploma from an accredited high school program). This variable is dichotomous due to its binary outcome. According to Hox (2010), dichotomous outcomes violate the normality assumption, thus making HGLM an appropriate method of analyses for this study. HGLM offers a coherent modeling

framework for multilevel data with nonlinear structural models and non-normally distributed errors (Raudenbush & Bryk, 2002, p.292).

Two-level HGLM were specified in answering the three research questions addressed in this study. The level-1 HGLM specifies students as the level-1 units. There are three parts in the HGLM level-1 model: a sampling model, a link function, and a structural model.

Bernoulli distribution. The dependent variable, HSDO, is a dichotomous variable as discussed previously, and thus has a Bernoulli distribution. The HGLM specified uses a Bernoulli sampling model and logit link (Raudenbush & Bryk, 2002). The level-1 sampling model is the level-1 probability distribution of a student's dropout episode, specified as follows:

$$Y_{ij}|\varphi_{ij} \sim \text{Ber}(\varphi_{ij})$$

where outcome variable (HSDO) Y_{ij} is 1 if student *i* in school *j* is a dropout, and 0 if otherwise. Y_{ij} has a Bernoulli distribution with the probability of success φ_{ij}. Raudenbush & Bryk explained next that the level-1 link function transforms the outcome variable Y_{ij} to η_{ij}, where η_{ij} is the log of the odds (i.e., logit) of a student dropping out of high school (p. 295). This link function ensures that the predictions lie within a defined interval, in this case the probability of a student dropping out of high school that has a value between 0 and 1. The level-1 link function is specified as follows:

$$\eta_{ij} = \log\left(\frac{\varphi_{ij}}{1-\varphi_{ij}}\right)$$

Next, the transformed predicted value η_{ij} is related to level-1 predictors through a linear model and this is known as the level-1 structural model as specified below:

$$\eta_{ij} = \beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + \ldots + \beta_{pj}X_{pij} + \ldots + \beta_{Pj}X_{Pij}$$

In this model, η_{ij}, the log odds of student *i* in school *j* dropping out of high school, is a function of level-1 coefficients and covariates. The X_s (s = 1, 2, …, P) refers to level-1 (student level) independent variables in this study that include curriculum track, demographic characteristics, academic prior achievement and risk factors, and academic and career aspirations.

The level-2 HGLM model specifies schools as the level-2 units, thus capturing the random effects that will result from across school variances. The model is specified as below:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}SF_{1j} + ... + \gamma_{0Q_0}SF_{Q_0 j} + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}SF_{1j} + ... + \gamma_{0Q_1}SF_{Q_1 j} + u_{1j}$$

……

$$\beta_{pj} = \gamma_{p0} + \gamma_{p1}SF_{1j} + ... + \gamma_{pq}SF_{qj} + \gamma_{0Q_p}SF_{Q_p j} + u_{pj}$$

……

$$\beta_{Pj} = \gamma_{Pj} + \gamma_{P1}SF_{1j} + ... + \gamma_{pQ_P}SF_{Q_P j} + u_{Pj}$$

In this model, SF represents a level-2 (school level) independent variable such as school type, average SES, non-Asian minority composition, school urbanicity, and if CTE courses were offered. u_{0j} through u_{pj} represent level-2 random effects, which are school unique effects on the level-1 regression coefficients, and they are assumed to have multivariate normal distribution with a mean of 0, and the variance-covariance matrix τ with size (P + 1). That is,

$$\underset{\sim}{u}_j = \begin{pmatrix} u_{0j} \\ u_{1j} \\ u_{2j} \\ ... \\ u_{pj} \end{pmatrix} \sim N(0,\tau) \text{ for } \tau = \begin{pmatrix} \tau_{00} & \tau_{01} & ... & \tau_{0P} \\ \tau_{10} & \tau_{11} & ... & ... \\ ... & ... & ... & ... \\ \tau_{P0} & ... & ... & \tau_{PP} \end{pmatrix}$$

Raudenbush and Bryk (2002) explained that the β parameters in the above level-2 model refer to the level-1 model coefficients, u_{pj} *(p = 0, 1, ..., P)* are the level-2 random effects, and the γ parameters are the level-2 coefficients (p. 23). γ_{00} is the overall average log-odds of a dropout episode controlling for the student level predictors X_1 through X_P and the school level predictors (SF) in the model. γ_{pq} is the average impact of SF_{qj} on β_{pj} controlling for all student and school level predictors in the model.

In the WHLM version 7.21p software, the estimation method for HGLM with binary outcome penalized quasi likelihood (PQL) in its default estimation. Although PQL "is less computationally intensive" and produces acceptable estimation, but it tends to produce bias estimates (Newsom, 2011, p. 2). However, in this study, I have chosen the Adaptive Gaussian Quadrature (AGQ) method with the option of 20 quadrature points and 10,000 macro iterations which is good enough to obtain the closest maximum likelihood estimate. AGQ is a method that integrates level-2 random error which appears in likelihood functions.

Model-building strategy. To find the best-fitting HGLM model for the research questions in this study, variables were included step by step. The first research question was, "To what extent do high school students of various curriculum tracks differ in the likelihood of dropping out of high school, after controlling for major possible individual differences?" This question was addressed through specifying curriculum track as a predictor of high school dropout likelihood in the level-1 HGLM, controlling for major individual level covariates that have influence on curriculum track and dropout decisions based on the review of literature. Which curriculum tracks are included in the model were determined by extended descriptive analysis as proposed earlier. In answering research questions 1 and 2, the following sequence was employed:

1. First, the unconditional HGLM model was defined with no level-1 or level-2 predictor variables. This analysis provided an indication on whether the school-level variability in dropout likelihood was significant. The significance in school-level variability that was found justified the use of HGLM over linear regression as the school-level variability must be taken into consideration as ELS has a nested data structure.
2. The baseline model was then defined with only curriculum track choice as the level-1 predictor variable to investigate the main effect that it has on dropout likelihood.
3. Level-1 predictors were then included sequentially, based on their categories (academic background, academic and career aspiration, and school-sponsored activity participation).
4. After significant level-1 predictors were identified, level-2 predictors were then included in the model to derive to the most parsimonious model. School-level covariates identified from the literature as having influence on dropouts were included in the level-2 models. The results from the analysis were used to address research question 2: "How do school factors related to curriculum track contribute to the likelihood of students dropping out of high school?"

Research question three was: "How do different career and technical education areas profile in the likelihood of dropping out of high school?" This question was addressed by creating a different subsample of the ELS data to include only the 2002 sophomore cohort with transcript data who were occupational concentrators. The analysis was conducted by formulating a new HGLM that include 6 indicator variables to represent 7 CTE program areas in the place of curriculum tracks as dropout predictors in the level-1 models. Steps in building the model is the same as the steps in answering research questions 1 and 2. The CTE program area grouping was obtained from the preliminary descriptive analysis and the categories are listed in Table 3.5.

Covariates used in the previous analysis (demographic characteristics, academic prior achievement and risk factor, academic and career aspirations, and school-sponsored activity participation) were included. Thus, specifications of level-2 models are identical with the analysis on curriculum track choice and dropout.

Results for all key models were presented in Chapter 4. There are two results that are produced by HGLM in analyzing models with nonlinear link functions, namely unit-specific and population average results. According to Raudenbush and Bryk (2002), there is a clear distinction between the two results in which unit-specific model results produce level-2 variance estimate whereas population average model outputs integrate level-2 random error out so that the fixed effect parameters represent the overall average effect across schools. In other words, the "unit-specific model provides an entire distribution of outcomes over all level- 2 units" while population-average results can be deduced as one characteristic of the distribution of the unit-specific results" (p. 304). For interpretation purposes, I am interested in the inference of particular schools and inferences on variance component availability across schools and as such, both results were resported. Population average model results can be interpreted as the overall average effect of each predictor across school. Raudenbush and Bryk also indicated that population average model results are closer to descriptive statistic.

Scope and Limitations

The survey design nature of the ELS study imposes a limitation on the ability to infer a causal relationship between curriculum track and the likelihood of dropping out of high school. That is, as explained in the review of literature, curriculum track choice does not occur through random assignment as most often students are placed in courses depending upon various factors such as demographics, prior academic achievement, interest, post-secondary plans, and

teacher/counselor recommendations (Oakes, 1985; Rosenbaum, 1980). Therefore, a truly randomized assignment of students to various curriculum tracks never occurs in the education system. According to Dehejia and Wahba (2002), a causal effect estimate could be biased due to the presence of selection bias in comparing non-experimental treatment and control groups. The two groups may "differ systematically with respect to relevant characteristics and, therefore, may not be directly comparable" (Rosenbaum & Rubin, 1984, p.516). Without taking fully into account the self-selection mechanism of curriculum track choice mentioned above, the results would be biased. Although I will exercise the possible maximum statistical control by including the covariates to account for major individual differences in HGLM, it may not be as exhaustive as other statistical procedures such as propensity score matching methods. It is also possible that the linear form of control variables included in the model may not be good enough to eliminate bias from this study. Any conclusions with regard to the impact of occupational track on the likelihood of dropping out of high school must be carefully interpreted, as the study is not experimental in its nature.

As explained previously, the contingency table produced reveals a non-occurrence of dropouts among dual-tracked students. The exclusion of dual track students from HGLM was exercised after further investigation using descriptive analysis as mentioned earlier. Thus, a thorough comparative analysis on the four distinct tracks was unable to be performed via HGLM.

One of the imperative predictors of high school dropout likelihood is middle school experience. According to Plank (2001), middle school experiences do play a role in students' high school career success in terms of their academic achievement and completion. However, the only available information in the ELS dataset related to schooling experiences prior to high

school are the number of grades repeated and the last grade repeated in school. Therefore, one limitation in this study is that the pre-high school experience was only be defined by the grade retention information, presented as a risk factor. There are other national datasets from NCES that have more information on middle school experiences available (GPA, standardized test scores, etc.), such as the National Education Longitudinal Study of 1988 (NELS88), but the curriculum tracks in ELS are more current and up-to-date, especially in terms of graduation requirements and CTE courses' definitions.

Summary

In this chapter, the ELS dataset was used to analyze the relationship between curriculum track and high school dropout likelihood based on the three research questions forwarded in the first chapter of this study was described in detail. The analyses plan, including sampling, weighting, variables, and the methodology, HGLM, were also presented. This chapter also described the descriptive statistics of major dependent and independent variables involved based on preliminary analyses to provide an overview of distribution patterns of the ELS dataset related to high school dropout likelihood and curriculum track.

CHAPTER 4

FINDINGS

The purpose of this study was to investigate the association between curriculum track choices and the likelihood of dropping out of high school. To accomplish this task, an overview of the major variables of interest in the study, namely curriculum track choices and dropout likelihood, was captured in Chapter 3 through descriptive analyses performed on the Education Longitudinal Study of 2002 (ELS) dataset. Detailed descriptive analyses were then conducted to explore the relationship patterns between predictors associated with dropouts, established from a thorough review of literature, and dropout likelihood. The Hierarchical Generalized Linear Modeling (HGLM) models were then built to explain the relationships between curriculum tracks, other predictors, and dropout likelihood. In this chapter, descriptive analyses are presented first, and then HGLM results follow, organized based on the research questions that were raised in Chapter 1:

7. To what extent do high school students of various curriculum tracks differ in the likelihood of dropping out of high school, after controlling for major possible individual differences?

8. How do institutional factors related to curriculum track (such as minority composition, level of neighborhood poverty, available funding, and CTE courses offered) associate with the likelihood of students dropping out of high school?

9. How do different career and technical education areas differ in the likelihood of dropping out of high school?

Research questions 1 and 2 were addressed by the same HGLM model built to investigate curriculum track differences, but research question 3 was addressed via a separate HGLM model that addressed occupational concentrators exclusively. Therefore, this chapter will be presented in two parts, (a) Part 1 will address research questions 1 and 2, and (b) Part 2 addresses research question 3.

Part 1: Curriculum Track Choice and Dropout Likelihood

Preliminary descriptive analysis on the outcome variable, dropout (HSDO), and curriculum track (TRACK) was performed to determine the methodology to be used. The results were presented in Chapter 3. As a recap, dual track concentrators had a 0% dropout rate, and general track participants had the highest dropout rate of 13.9%. Results were shown in Table 3.4. As mentioned previously in Chapter 3, the Hierarchical Generalized Linear Modeling (HGLM) used to predict dropout likelihood among the study participants excluded dual track concentrators in the model due to its 0% dropout rate, as it would produce negative infinity logit. Dual track participants were included in the descriptive analyses to compare their characteristics with students of other tracks.

Descriptive Analyses

Detailed descriptive analyses were performed on each of the predictor variables listed in Chapter 3 (Table 3.1) to investigate their relationship with dropout likelihood. Total sample size for this study is n = 11,932 after the selection criteria described in Chapter 3 were used in determining participants. All analyses were weighted using normalized weights, calculated based on the second follow-up transcript weight, F2QTSCWT, available from ELS dataset.

Level -1 (student level) predictor: Demographic. The demographic variables included in this analysis were gender, race, and socioeconomic status (SES). These three variables were

discussed heavily in the literature to have had influences on dropout likelihood and curriculum track choices.

Gender. There were a total of 5,909 (49.5%) male and 6,023 (50.5%) female participants in this study. Table 4.1 shows that male participants' dropout rate was 11.2%, higher than female participants' rate of 7.3%.

Table 4.1

Gender and Dropout Crosstabulation

		High School Dropout		Total
		Not Dropout	Dropout	
Male	Count	5248	662	5910
	% within gender	88.8%	11.2%	100.0%
	% within dropout	48.4%	60.1%	49.5%
Female	Count	5584	439	6023
	% within gender	92.7%	7.3%	100.0%
	% within dropout	51.6%	39.9%	50.5%
Total	Count	10832	1101	11933
	% within gender	90.8%	9.2%	100.0%
	% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 1) = 54.524$, $p<0.001$
Note 2. Counts were weighted using student level normalized weights.

The distribution of male and female participants in the curriculum tracks is shown in Table 4.2. A higher percentage among female participants in the academic track (24.1%) was observed compared to male participants (20.6%). Higher percentages of male students were observed in the occupational and dual tracks.

Table 4.2

Gender and Curriculum Track Crosstabulation

		High School Curriculum Track				Total
		General	Academic	Occupational	Dual	
Male	Count	3462	1216	1041	191	5910
	% within gender	58.6%	20.6%	17.6%	3.2%	100.0%
	% within curriculum track	48.0%	45.6%	60.9%	54.9%	49.5%
Female	Count	3746	1452	668	157	6023
	% within gender	62.2%	24.1%	11.1%	2.6%	100.0%
	% within curriculum track	52.0%	54.4%	39.1%	45.1%	50.5%
Total	Count	7208	2668	1709	348	11933
	% within gender	60.4%	22.4%	14.3%	2.9%	100.0%
	% within curriculum track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 115.737$, $p<0.001$
Note 2. Counts were weighted using student level normalized weights.

Race. Participants were made up of 61.4% Whites, 14.0% African Americans, 15.2% Hispanics, 3.9% Asians, Hawaiians or Pacific Islanders (categorized as "Asians"), and 5.5% participants of more than 1 race, American Indian or Alaskan Natives. The last group was categorized under "others" for the purposes of this study. In terms of dropout rates, Asians had the lowest dropout rate, with4.1% out of 464 participants dropping out. On the other hand, Hispanics and African Americans had dropout rates of 14.0% and 13.6% respectively. The group "others" had the highest dropout rate with 14.2%, and 6.9% out of 7,327 White participants dropped out of school within the study period. Results are shown in Table 4.3.

Table 4.3

Race and Dropout Crosstabulation

		High School Dropout Status		
		Not Dropout	Dropout	Total
African American	Count	1441	226	1667
	% within race	86.4%	13.6%	100.0%
	% within dropout	13.3%	20.5%	14.0%
Asian	Count	445	19	464
	% within race	95.9%	4.1%	100.0%
	% within dropout	4.1%	1.7%	3.9%
Hispanic	Count	1559	253	1812
	% within race	86.0%	14.0%	100.0%
	% within dropout	14.4%	23.0%	15.2%
Others	Count	567	94	661
	% within race	85.8%	14.2%	100.0%
	% within dropout	5.2%	8.5%	5.5%
White	Count	6819	508	7327
	% within race	93.1%	6.9%	100.0%
	% within dropout	63.0%	46.2%	61.4%
Total	Count	10831	1100	11931
	% within race	90.8%	9.2%	100.0%
	% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 166.251$, $p<0.001$
Note 2. Counts were weighted using student level normalized weights.

For all race groups, more than 50% of the participants followed the general curriculum track. Asians had the highest participation rate in the academic track (35.5%), Whites had the

highest participation rate in the occupational track (15.3%), and African Americans had the highest participation rate in the dual track (4.0%). Detailed results are shown in Table 4.4.

Table 4.4

Gender and Curriculum Track Crosstabulation

		Curriculum track				Total
		General	Academic	Occupational	Dual	
African American	Count	1152	201	248	66	1667
	% within race	69.1%	12.1%	14.9%	4.0%	100.0%
	% within track	16.0%	7.5%	14.5%	18.9%	14.0%
Asian	Count	261	165	27	12	465
	% within race	56.1%	35.5%	5.8%	2.6%	100.0%
	% within track	3.6%	6.2%	1.6%	3.4%	3.9%
Hispanic	Count	1351	214	219	28	1812
	% within race	74.6%	11.8%	12.1%	1.5%	100.0%
	% within track	18.7%	8.0%	12.8%	8.0%	15.2%
Others	Count	452	104	91	14	661
	% within race	68.4%	15.7%	13.8%	2.1%	100.0%
	% within track	6.3%	3.9%	5.3%	4.0%	5.5%
White	Count	3991	1984	1123	229	7327
	% within race	54.5%	27.1%	15.3%	3.1%	100.0%
	% within track	55.4%	74.4%	65.7%	65.6%	61.4%
Total	Count	7207	2668	1708	349	11932
	% within race	60.4%	22.4%	14.3%	2.9%	100.0%
	% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 14) = 479.264$, $p<0.001$
Note 2. Counts were weighted using student level normalized weights.

Socioeconomic status (SES). The ELS dataset provides a continuous SES variable, F1SES2. According to the description available in the National Center for Education Statistics' (NCES) ELS online database (EDAT), this variable was determined by students' and parents' questionnaires and its value was determined by five components – fathers' or guardians'

education, mothers' or guardians' education, family income, fathers' or guardians' occupation, and mothers' or guardians' occupation. The value ranges from -2.12 to 1.97.

Table 4.5 shows the SES means comparison between high school dropouts and those who graduated or were still in school during the study period. The dropouts had a lower SES mean of -0.391 with a standard deviation of 0.597. An ANOVA analysis was conducted to investigate differences in the SES means between dropouts and non-dropouts, and the results revealed significant differences between the two groups at $p<0.05$ level.

Table 4.5

SES Means Comparison – Dropouts

High School Dropout Status	Mean	N	Std. Deviation	Minimum	Maximum
Not Dropout	0.036	10,832	0.716	-2.12	1.97
Dropout	-0.391	1,100	0.597	-2.12	1.80
Total	0.003	11932	0.717	-2.12	1.97

Note 1. $F_{obs}(df_1 = 1, df_2=11,929) = 364.936$, $p<0.001$
Note 2. Counts were weighted using student level normalized weights.

In Table 4.6, academic track concentrators had the highest SES mean of 0.448, and occupational track concentrators had the lowest SES mean of -0.216. ANOVA analysis results revealed significant differences between the different curriculum tracks in terms of SES, and a Tukey HSD post-hoc analysis suggested the differences were significant between all groups.

Table 4.6
SES Means Comparison – Curriculum Track

High School curriculum track	Mean	N	Std. Deviation	Minimum	Maximum
General	-0.055	6831	0.721	-2.12	1.97
Academic	0.448	3266	0.725	-1.86	1.97
Occupational	-0.216	1515	0.603	-1.81	1.97
Dual	0.104	320	0.682	-1.70	1.72
Total	0.066	11932	0.747	-2.12	1.97

Note 1. $F_{obs}(df_1 = 3, df_2=11,927) = 417.628$, $p<0.001$. Tukey HSD post-hoc revealed significant differences between all of the curriculum tracks with each other at $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Level -1 (student level) predictor: Academic prior achievement. In this study, academic prior achievement is measured through three variables, namely 9th grade GPA, Algebra 1 course taking, and grade retention. A continuous variable is available in the ELS dataset for overall 9th grade GPA (F1RGP9). Algebra 1 course taking variable (TookAlgebra1) was determined from a combination of Algebra 1 course credits that participants have completed (F1RAL_1C) available in the restricted ELS dataset and the highest mathematics course that the participants took during their high school career (F1HIMATH) available from the public use dataset. Grade retention variable, HeldBack, was determined from a combination of two related variables, BYP46 ("10th grader ever held back a grade") and F1N11 ("Ever held back a grade"). BYP46 was obtained from the base year parental questionnaire and F1N11 was from the first follow up student questionnaire. Due to a high non-response rate (15.9%) for the two variables, non-respondents were treated as a category and their influence on dropout was compared with those who were held back at least a grade in school and those who were never held back.

9th grade GPA. The overall 9th grade GPA was used in this study as a measure of participants' early achievement in high school. As curriculum tracking most likely takes place as early as eighth grade through ninth grade in American public schools, the 9th grade GPA information is the earliest academic measure that is available from ELS. Table 4.7 reflects the GPA means comparison between dropouts and non-dropouts where dropouts had lower GPA mean of 1.79 as compared to non-dropouts with a mean of 2.79. ANOVA analysis suggested the GPA mean differences between dropouts and non-dropouts were significant at $p<0.001$.

Table 4.7

GPA Means Comparison – Dropout

HS Dropout Status	Mean	N	Std. Deviation	Minimum	Maximum
Not Dropout	2.79	10832	0.793	.00	4.00
Dropout	1.79	1100	0.731	.00	4.00
Total	2.70	11932	0.811	.00	4.00

Note 1. $F_{obs}(df_1 = 1, df_2=11,929) = 1606.904$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.8 shows the means comparison between the four curriculum tracks. Participants who followed the academic and dual tracks had mean GPAs of 3.30 and 3.16 respectively, and lower means were observed for general and occupational tracks (2.50 for both tracks). From the analysis of variance (ANOVA) performed to investigate GPA mean differences between the curriculum tracks, all of the curriculum track concentrators differ from each other at $p<0.001$, except between general and occupational track concentrators, which showed no significant differences between the two groups in the participants' mean GPA.

Table 4.8

Overall 9th Grade GPA Means Comparison – Curriculum Track

HS curriculum track	Mean	N	Std. Deviation	Minimum	Maximum
General	2.50	7208	0.843	.00	4.00
Academic	3.30	2668	0.550	0.93	4.00
Occupational	2.50	1708	0.733	.00	4.00
Dual	3.16	348	0.650	1.13	4.00
Total	2.70	11932	0.838	.00	4.00

Note 1. $F_{obs}(df_1 = 3, df_2=11,927) = 417.628$, $p<0.001$. Tukey HSD post-hoc revealed significant differences between all of the curriculum tracks with each other at $p<0.001$, except between general and occupational tracks.
Note 2. Counts were weighted using student level normalized weights.

Algebra 1 course taking. Based on literature, curriculum choice or the sequence of courses that students take in high school depends on gatekeeper courses, and mathematics course taking is one of the most important. If students complete Algebra 1 early in their schooling careers, as early as 8th grade, most likely these students will progress to higher-level math courses (Algebra 2, Trigonometry, Pre-Calculus, or Calculus) required for college enrollment (Atanda, 1999; Berkner & Chavez, 1997). This will subsequently maneuver them towards an academic or a dual curriculum track. Table 4.9 shows that participants who took Algebra 1 had a lower dropout rate (8.0%) than participants who did not take Algebra 1 (26.4%). Most participants who followed the academic track (99.3%) and dual track (98.6%) took Algebra 1 during their schooling years. The comparison between the tracks in their Algebra 1 course-taking is shown in Table 4.10.

Table 4.9

Algebra 1 Course-Taking and Dropout Crosstabulation

			High School Dropout Status		
			Not Dropout	Dropout	Total
Algebra 1 course-taking	Did not take Algebra 1	Count	570	204	774
		% within Algebra 1	73.6%	26.4%	100.0%
		% within dropout	5.3%	18.5%	6.5%
	Took Algebra 1	Count	10262	896	11158
		% within Algebra 1	92.0%	8.0%	100.0%
		% within dropout	94.7%	81.5%	93.5%
Total		Count	10832	1100	11932
		% within Algebra 1	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 1) = 290.467$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.10

Algebra 1 Course-Taking and Curriculum Track Crosstabulation

			High School Curriculum Track				
			General	Academic	Occupational	Dual	Total
Algebra 1	Did not take Algebra 1	Count	594	20	155	5	774
		% within Algebra 1	76.7%	2.6%	20.0%	.6%	100.0%
		% within track	8.2%	.7%	9.1%	1.4%	6.5%
	Took Algebra 1	Count	6614	2648	1554	343	11159
		% within Algebra 1	59.3%	23.7%	13.9%	3.1%	100.0%
		% within track	91.8%	99.3%	90.9%	98.6%	93.5%
Total		Count	7208	2668	1709	348	11933
		% within Algebra 1	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 214.772$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Held back. Being held back a grade in students' schooling experience has been argued to have an influence on high school dropout likelihood. Due to the high non-response rate (15.9%) for this variable in the ELS database, I have decided to keep the non-respondents as a valid category in this analysis, and compare the group with those who have been held back and those who have not been held back a grade since kindergarten until the end of the study period. The non-respondents had the following characteristics:

1. 51.0% males and 49.0% females,
2. 21.9% Whites, 25.0% African Americans, 16.5% Hispanics, 25.0% Asians, and 18.8% other races,
3. Mean SES of -0.185 with standard deviation of 0.64,
4. Mean GPA of 2.42 with standard deviation of 0.85, and
5. 90.5% took Algebra 1 and 9.5% did not take Algebra 1.

Based on the descriptive analysis performed to see the possible relationship between grade retention and dropout, Table 4.11 shows the highest dropout rate among participants who were held back at least once (23.8%), and the lowest dropout rate among participants who were never held back (6.2%).

From Table 4.12, occupational track concentrators had the highest held back rate of 13.8%, and the lowest was among dual track concentrators (2.6%). 86.6% academic concentrators and 84.8% dual concentrators responded that they were never held back in school.

Table 4.11

Held Back and Dropout Crosstabulation

			High School Dropout Status		
			Not Dropout	Dropout	Total
Student ever held back a grade throughout school	Non-respondent	Count	1626	276	1902
		% within held back	85.5%	14.5%	100.0%
		% within dropout	15.0%	25.1%	15.9%
	Never held back	Count	8314	545	8859
		% within held back	93.8%	6.2%	100.0%
		% within dropout	76.8%	49.5%	74.3%
	Held back at least once	Count	891	279	1170
		% within held back	76.2%	23.8%	100.0%
		% within dropout	8.2%	25.4%	9.8%
Total		Count	10831	1100	11931
		% within held back	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df=2) = 462.299$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.12

Held Back and Curriculum Track Crosstabulation

			High School Curriculum Track				
			General	Academic	Occupational	Dual	Total
Student ever held back a grade throughout school	Non-respondent	Count	1275	282	301	44	1902
		% within held back	67.0%	14.8%	15.8%	2.3%	100.0%
		% within track	17.7%	10.6%	17.6%	12.6%	15.9%
	Never held back	Count	5081	2310	1172	295	8858
		% within held back	57.4%	26.1%	13.2%	3.3%	100.0%
		% within track	70.5%	86.6%	68.6%	84.8%	74.2%
	Held back at least once	Count	851	76	235	9	1171
		% within held back	72.7%	6.5%	20.1%	.8%	100.0%
		% within track	11.8%	2.8%	13.8%	2.6%	9.8%
Total		Count	7207	2668	1708	348	11931
		% held back	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 6) = 354.997$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Level -1 (student level) predictor: School-sponsored activities participation. The ELS dataset provides several variables related to student participation in extracurricular and co-curricular activities (school-sponsored activities). For the purposes of this study, I have chosen two variables, the first from the base year student questionnaire, BYS42, and the second is from the first follow-up student questionnaire, F1S27. Both variables were responses from participants on the number of hours they spent each week for school-sponsored activities. I have combined both variables and categorized them as "participated in school-sponsored activities" if they spent at least one hour a week, and "did not participate in school-sponsored activities" if they spent 0 hours a week.

Table 4.13 shows a higher dropout rate among those who did not participate in school-sponsored activities (21.9%) as compared to those who did participate (5.1%). Academic track concentrators show the highest activity participation rate (91.5%) and occupational track shows the lowest rate (67.6%) in Table 4.14.

Table 4.13

School-sponsored Activities Participation and Dropout Crosstabulation

			High School Dropout		
			Not Dropout	Dropout	Total
Participation in school-sponsored extra-curricular activities	No participation	Count	2281	641	2922
		% within extra-curricular	78.1%	21.9%	100.0%
		% within dropout	21.1%	58.2%	24.5%
	Participated at least 1 hour a week	Count	8551	460	9011
		% within extra-curricular	94.9%	5.1%	100.0%
		% within dropout	78.9%	41.8%	75.5%
Total		Count	10832	1101	11933
		% within extra-curricular	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 1) = 746.425$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.14

School-sponsored Activities Participation and Curriculum Track Crosstabulation

			High School Curriculum Track				
			General	Academic	Occupational	Dual	Total
Participation in school-sponsored extra-curricular activities	No participation	Count	2098	226	553	44	2921
		% within extra-curricular	71.8%	7.7%	18.9%	1.5%	100.0%
		% within track	29.1%	8.5%	32.4%	12.6%	24.5%
	Participated at least 1 hour a week	Count	5109	2442	1156	304	9011
		% within extra-curricular	56.7%	27.1%	12.8%	3.4%	100.0%
		% within track	70.9%	91.5%	67.6%	87.4%	75.5%
Total		Count	7207	2668	1709	348	11932
		% within extra-curricular	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 537.203$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Level -1 (student level) predictor: Post-secondary education plans. In the base year student questionnaire, the participants were asked to indicate how far in school they thought they would get, implying post-secondary education plans. The variable available in the dataset reflecting the responses was BYSTEXP (how far in school student thinks will get), and I have categorized the responses as no indication, high school or general education development (GED), 2-year college, and 4 year college and postgraduate. From the results obtained, the highest dropout rate was observed among participants who indicated high school or GED as their post-secondary plans (30.1%) and the lowest rate was observed among those who indicated 4-year college and postgraduate studies (5.9%). Detailed results are shown in Table 4.15.

Table 4.15

Post-secondary Education Plans and Dropout Crosstabulation

			High School Dropout Status		Total
			Not Dropout	Dropout	
Post-secondary education plans	No indication	Count	1036	203	1239
		% within education plans	83.6%	16.4%	100.0%
		% within dropout	9.6%	18.5%	10.4%
	High school/GED	Count	535	230	765
		% within education plans	69.9%	30.1%	100.0%
		% within dropout	4.9%	20.9%	6.4%
	2-year college	Count	645	127	772
		% within education plans	83.5%	16.5%	100.0%
		% within dropout	6.0%	11.5%	6.5%
	4-year college & postgraduate	Count	8616	540	9156
		% within education plans	94.1%	5.9%	100.0%
		% within dropout	79.5%	49.1%	76.7%
Total		Count	10832	1100	11932
		% within education plans	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 642.162$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

A majority of participants who followed the academic track (93.3%) and dual track (91.4%) indicated 4-year college or postgraduate studies as their post-secondary education plans. 15.1%occupational track concentrators and 6.8% general track participants indicated attending a 2-year college post-secondary education plan. The results are shown in Table 4.16.

Table 4.16

Post-secondary Education Plans and Curriculum Track Crosstabulation

			High School Curriculum Track				Total
			General	Academic	Occupational	Dual	
Post secondary education plans	No indication	Count	883	139	194	23	1239
		% within education plans	71.3%	11.2%	15.7%	1.9%	100.0%
		% within track	12.3%	5.2%	11.4%	6.6%	10.4%
	High school/GED	Count	549	19	192	3	763
		% within education plans	72.0%	2.5%	25.2%	0.4%	100.0%
		% within track	7.6%	.7%	11.2%	0.9%	6.4%
	2-year college	Count	489	20	258	4	771
		% within education plans	63.4%	2.6%	33.5%	0.5%	100.0%
		% within track	6.8%	.7%	15.1%	1.2%	6.5%
	4-year college & postgraduate	Count	5286	2489	1063	317	9155
		% within education plans	57.7%	27.2%	11.6%	3.5%	100.0%
		% within track	73.3%	93.3%	62.3%	91.4%	76.8%
Total		Count	7207	2667	1707	347	11928
		% within education plans	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 9) = 841.333$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Level -1 (student level) predictor: Career plans. In ELS base year student questionnaire, the participants were asked to indicate what they thought their careers would be at the age of 30. There were no choices for the participants to choose from, so they were free to respond, and in the dataset, their responses were categorized. The variable that records the categorized responses is BYOCC30 (occupation at age 30). In this study, I have further classified

the responses, and this is shown in Table 4.17. There is a 10.8% non-response rate for this variable; therefore I have decided to include the non-respondents as a valid category to preserve the number of cases.

Table 4.17
Career Plan Categories

ELS Dataset Participant Response Category	This Study's Career Category
Non-respondent	Non-respondent
Don't know	Don't know
Craftsperson Farmer Laborer Operative Service Technical	Blue collar/skilled
Clerical Manager Professional A and Professional B Owner Sales School Teacher	White collar/professional/office
Military Protective services	Military and protective service
Homemaker Other	Homemaker and others

A majority of the participants (46.9%) indicated white-collar careers as their plans, followed by 30.3% participants who indicated that they did not know what their careers at age 30 would be. Table 4.18 shows the comparison between dropouts and non-dropouts in terms of their career plans. The highest dropout rate was observed among participants who indicated blue-collar career plans (13.5%) while both white-collar and homemaker/other categories had the lowest dropout rate (6.7%).

Table 4.19 shows career plan comparison between the different curriculum tracks. 16.3% of participants who followed the occupational track and 8.5% of participants who followed the general track indicated blue collar/skilled jobs as their career plan. No one in the dual track indicated homemaker and other jobs as their career plan. In all curriculum tracks, most participants indicated white collar/professional/office jobs as their career projection at age 30.

Table 4.18

Career Plan and Dropout Crosstabulation

			High School Dropout		Total
			Not Dropout	Dropout	
Career at age 30 projection	Non-respondent	Count	1129	157	1286
		% within career	87.8%	12.2%	100.0%
		% within dropout	10.4%	14.3%	10.8%
	Don't know	Count	3227	392	3619
		% within career	89.2%	10.8%	100.0%
		% within dropout	29.8%	35.7%	30.3%
	Blue collar/skilled	Count	899	140	1039
		% within career	86.5%	13.5%	100.0%
		% within dropout	8.3%	12.7%	8.7%
	White collar/ office/professional	Count	5225	373	5598
		% within career	93.3%	6.7%	100.0%
		% within dropout	48.2%	33.9%	46.9%
	Military & protective service	Count	297	33	330
		% within career	90.0%	10.0%	100.0%
		% within dropout	2.7%	3.0%	2.8%
	Homemaker & other	Count	56	4	60
		% within career	93.3%	6.7%	100.0%
		% within dropout	.5%	.4%	.5%
Total		Count	10833	1099	11932
		% within career	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 5) = 91.939$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.19
Career Plan and Curriculum Track Crosstabulation

			HS curriculum track				
			General	Academic	Occupational	Dual	Total
Career at age 30 projection	Non-respondent	Count	872	193	192	29	1286
		% within career	67.8%	15.0%	14.9%	2.3%	100.0%
		% within track	12.1%	7.2%	11.2%	8.3%	10.8%
	Don't know	Count	2259	728	542	90	3619
		% within career	62.4%	20.1%	15.0%	2.5%	100.0%
		% within track	31.3%	27.3%	31.7%	25.9%	30.3%
	Blue collar/ skilled	Count	615	118	278	29	1040
		% within career	59.1%	11.3%	26.7%	2.8%	100.0%
		% within track	8.5%	4.4%	16.3%	8.3%	8.7%
	White collar/ office/ professional	Count	3210	1560	633	196	5599
		% within career	57.3%	27.9%	11.3%	3.5%	100.0%
		% within track	44.5%	58.4%	37.0%	56.3%	46.9%
	Military & protective service	Count	211	57	58	4	330
		% within career	63.9%	17.3%	17.6%	1.2%	100.0%
		% within track	2.9%	2.1%	3.4%	1.1%	2.8%
	Homemaker & other	Count	41	13	7	0	61
		% within career	67.2%	21.3%	11.5%	.0%	100.0%
		% within track	0.6%	0.5%	0.4%	0.0%	0.5%
Total		Count	7208	2669	1710	348	11935
		% within career	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 15) = 366.998$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Level-2 (school level) predictors. In this study, school level predictors included were school type (public or private school), school mean SES, school non-Asian minority composition, school urbanicity, and CTE course offerings. There were a total of 734 schools that were included. The unweighted descriptive of these level-2 predictors are presented in Table 4.20 (categorical variables) and Table 4.21 (continuous variables). Detailed descriptive analysis results of level-2 predictors associated with participants are presented in the sections following the two tables.

Table 4.20

Level-2 (School-level) Categorical Variables Descriptive

Variable	Categories	*n*	%
School type	Public school	566	77.1%
	Private school	168	22.9%
School urbanicity	Rural area	136	18.5%
	Suburban area	353	48.1%
	Urban area	245	33.4%
CTE course offering	Non-respondent	100	13.6%
	Offered CTE courses	486	66.2%
	Did not offer CTE courses	148	20.2%

Table 4.21

Level-2 (School-level) Continuous Variables Descriptive

	N	Minimum	Maximum	Mean	Std. Deviation
School mean SES	734	-1.04	1.97	.0538	.454
Non-Asian minority composition	734	.00	1.00	.3416	.314

School type. The ELS dataset provides the variable BYSCTRL that indicates whether a school is public, Catholic, or other private school. For the purposes of this study, I have collapsed Catholic and other private school categories into one, named as private school. From Table 4.22, public schools are observed to have a dropout rate of 9.8%, higher than private schools' dropout rate of 2.4%.

Table 4.22

School Type and Dropout Crosstabulation

			High School Dropout		
			Not Dropout	Dropout	Total
Level 2 variable: Base year school type	Public school	Count	9929	1078	11007
		% withinschool type	90.2%	9.8%	100.0%
		% within dropout	91.7%	98.0%	92.2%
	Private school	Count	903	22	925
		% within school type	97.6%	2.4%	100.0%
		% within dropout	8.3%	2.0%	7.8%
Total		Count	10832	1100	11932
		% within school type	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 1) = 56.065$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

In terms of curriculum track, private school participants predominantly follow the general and academic tracks, with a participation rate of 50.5% and 46.6% respectively. A majority of participants in the public schools follow the general track (61.2%). In the occupational track, there was only a 2.2% participation rate in private schools, as compared to 15.3% in public schools. A higher participation rate in the dual track is also observed in public schools (3.1%) as compared to private schools (0.8%). Detailed results are shown in Table 4.23.

Table 4.23

School Type and Curriculum Track Crosstabulation

			High School Curriculum Track				Total
			General	Academic	Occupational	Dual	
Level 2 variable: Base year school type	Public school	Count	6740	2236	1689	341	11006
		% within school type	61.2%	20.3%	15.3%	3.1%	100.0%
		% within track	93.5%	83.8%	98.8%	98.0%	92.2%
	Private school	Count	467	431	20	7	925
		% within school type	50.5%	46.6%	2.2%	0.8%	100.0%
		% within track	6.5%	16.2%	1.2%	2.0%	7.8%
Total		Count	7207	2667	1709	348	11931
		% within school type	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 399.517$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

School mean SES. School mean SES is the variable used as a proxy to determine a school's poverty level as the literature stated a higher dropout rate among schools with higher poverty levels. From the means comparison results in Table 4.24, the school mean SES is lower for dropouts than non-dropouts. In terms of curriculum track, the highest school mean SES is among academic track concentrators, and the lowest among occupational track. However, based on ANOVA, there appears to be no significant differences in the school mean SES between dual and general tracks. The results can be found in Table 4.25.

Table 4.24

School Mean SES Means Comparison: Dropout

High School Dropout	Mean	N	Std. Deviation	Minimum	Maximum
Not Dropout	0.013	10832	0.401	-1.04	1.97
Dropout	-0.158	1100	0.336	-1.04	1.21
Total	-0.003	11932	0.398	-1.04	1.97

Note 1. $F_{obs}(df_1 = 1, df_2=11,929) = 187.005$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.25

School Mean SES Means Comparison: Curriculum Track

Curriculum track	Mean	N	Std. Deviation	Minimum	Maximum
General	-0.049	7208	0.384	-1.04	1.51
Academic	0.203	2668	0.426	-1.04	1.97
Occupational	-0.121	1708	0.299	-1.04	1.38
Dual	-0.053	348	0.326	-.65	1.25
Total	-0.003	11932	0.398	-1.04	1.97

Note 1. $F_{obs}(df_1 = 3, df_2=11,927) = 350.405$, $p<0.001$. Tukey HSD post-hoc revealed significant differences between all of the curriculum tracks with each other at $p<0.05$, except between dual and general tracks.
Note 2. Counts were weighted using student level normalized weights.

School non-Asian minority composition. In this study, non-Asian minority composition in a school is used as a school level predictor because it was found that the dropout rate for Asians and Whites are both significantly lower than other race groups (4.1% and 6.9% respectively). Therefore, Asians were not included in the minority composition. From the results shown in Table 4.26, dropouts came for schools with higher percentage of non-Asian minorities as compared to non-dropouts. Academic track concentrators were generally in schools with lower non-Asian minority composition than other curriculum tracks, but no statistically

significant differences in school non-Asian minority composition between dual and general tracks were observed. The results are reflected in Table 4.27.

Table 4.26

School Non-Asian Minority Composition Means Comparison: Dropout

High School Dropout	Mean	N	Std. Deviation	Minimum	Maximum
Not dropout	0.338	10832	0.299	0.00	1.00
Dropout	0.438	1100	0.320	0.00	1.00
Total	0.347	11932	0.302	0.00	1.00

Note 1. $F_{obs}(df_1 = 1, df_2=11{,}929) = 110.848$, $p<0.001$.
Note 2. Countswere weighted using student level normalized weights.

Table 4.27

School Non-Asian Minority Composition Means Comparison: Curriculum Track

Curriculum track	Mean	N	Std. Deviation	Minimum	Maximum
General	0.382	7208	0.313	0.00	1.00
Academic	0.269	2668	0.264	0.00	1.00
Occupational	0.313	1708	0.290	0.00	1.00
Dual	0.387	348	0.288	0.00	1.00
Total	0.347	11932	0.302	0.00	1.00

Note 1. $F_{obs}(df_1 = 3, df_2=11{,}927) = 104.576$, $p<0.001$. Tukey HSD post-hoc revealed significant differences between all of the curriculum tracks with each other at $p<0.001$, except between dual and general tracks.
Note 2. Counts were weighted using student level normalized weights.

School urbanicity. The ELS dataset provides a school-level variable that indicates whether a school is located in an urban, suburban, or rural area, BYURBAN. It was observed that schools in the urban area had the highest dropout rate (10.7%) while suburban area schools had the lowest rate (8.2%). Detailed results are reflected in Table 4.28.

Table 4.28

School Urbanicity and Dropout Crosstabulation

			High School Dropout		Total
			Not Dropout	Dropout	
School urbanicity	Urban	Count	3118	375	3493
		% within school urbanicity	89.3%	10.7%	100.0%
		% within dropout	28.8%	34.1%	29.3%
	Suburban	Count	5536	497	6033
		% within school urbanicity	91.8%	8.2%	100.0%
		% within dropout	51.1%	45.2%	50.6%
	Rural	Count	2178	228	2406
		% within school urbanicity	90.5%	9.5%	100.0%
		% within dropout	20.1%	20.7%	20.2%
Total		Count	10832	1100	11932
		% within school urbanicity	90.8%	9.2%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 2) = 16.729$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.29 shows that schools in the suburban and urban area's participation rate in the academic track is similar, at 23.1% and 22.9% respectively. Schools in the rural area had the highest participation rate in the occupational track (21.3%) but the lowest participation rate in the dual track (2.6%).

Table 4.29

School Urbanicity and Curriculum Track Crosstabulation

			High SchoolCurriculum Track				
			General	Academic	Occupational	Dual	Total
School urbanicity	Urban	Count	2227	799	362	104	3492
		% within urbanicity	63.8%	22.9%	10.4%	3.0%	100.0%
		% within track	30.9%	29.9%	21.2%	30.0%	29.3%
	Suburban	Count	3622	1395	835	181	6033
		% within urbanicity	60.0%	23.1%	13.8%	3.0%	100.0%
		% within track	50.2%	52.3%	48.9%	52.2%	50.6%
	Rural	Count	1359	474	512	62	2407
		% within urbanicity	56.5%	19.7%	21.3%	2.6%	100.0%
		% within track	18.9%	17.8%	30.0%	17.9%	20.2%
Total		Count	7208	2668	1709	347	11932
		% within urbanicity	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 6) = 143.979$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

School CTE Course Offering. In this study, school's offering of CTE courses is explored to see if it has any influences on dropout likelihood. This predictor is based on ELS's variable, BYA16, from the base year school administrative questionnaire. Schools were required to respond if they offered CTE courses at their schools. There was a 12.0% non-response rate, and I have decided to include the non-respondents as a valid category in this study, and compared this group with schools that offer and did not offer CTE. From Table 4.30, schools that offered CTE had a higher dropout rate (9.4%) than schools that did not offer CTE (5.6%). It was also

observed that schools which offered CTE courses had a higher participation rate in the occupational track (15.7%) than schools in the other categories. Results are shown in Table 4.31.

Table 4.30

CTE Courses Offered and Dropout Crosstabulation

			High School Dropout Status		Total
			Not Dropout	Dropout	
Level 2 Variable: CTE Courses offered at school?	Non-respondent	Count	1263	165	1428
		% within CTE Courses	88.4%	11.6%	100.0%
		% within HS Dropout	11.7%	15.0%	12.0%
	No	Count	1269	75	1344
		% within CTE Courses	94.4%	5.6%	100.0%
		% within HS Dropout	11.7%	6.8%	11.3%
	Yes	Count	8300	860	9160
		% within CTE Courses	90.6%	9.4%	100.0%
		% within HS Dropout	76.6%	78.2%	76.8%
Total		Count	10832	1100	11932
		% within CTE Courses	90.8%	9.2%	100.0%
		% within HS Dropout	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 2) = 30.885$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Table 4.31

CTE Courses Offered and Curriculum Track Crosstabulation

			High School Curriculum Track				Total
			General	Academic	Occupational	Dual	
CTE Courses offered at school?	Non-respondent	Count	913	283	182	51	1429
		% within CTE	63.9%	19.8%	12.7%	3.6%	100.0%
		% within track	12.7%	10.6%	10.7%	14.6%	12.0%
	No	Count	697	543	87	17	1344
		% within CTE	51.9%	40.4%	6.5%	1.3%	100.0%
		% within track	9.7%	20.4%	5.1%	4.9%	11.3%
	Yes	Count	5598	1842	1439	281	9160
		% within CTE	61.1%	20.1%	15.7%	3.1%	100.0%
		% within track	77.7%	69.0%	84.3%	80.5%	76.8%
Total		Count	7208	2668	1708	349	11933
		% within CTE	60.4%	22.4%	14.3%	2.9%	100.0%
		% within track	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 6) = 328.488$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Dual Track Participants' Characteristics

Preliminary descriptive analyses presented in Chapter 3 revealed that there were no dropouts for dual track concentrators, and therefore this group was excluded from the HGLM analysis. Since dual track participants were excluded from the analysis, a comparison on its magnitude of effect on dropout likelihood with other curriculum tracks in inconclusive. The characteristics of dual track participants were identified from the series of descriptive analysis conducted earlier in this chapter. The summary is presented in the following paragraphs.

There was a higher participation rate among males (3.2%) than females (2.6%) in the dual curriculum track. African Americans had the highest participation rate of 4.0%, while Hispanics had the lowest rate (1.5%). Dual track participants had a mean SES of 0.104 and mean GPA of 3.16. Both averages were lower than academic track participants', but higher than general and occupational track participants' averages. At school level, 98% of dual track participants attended public schools.

The results revealed that several student-level characteristics were comparable to the characteristics of academic track participants, such as Algebra 1 course taking, grade retention, school-sponsored activity participation, and post-secondary education plans. At the school level, both tracks are similar in participation rate by school urbanicity. The comparison can be found in Table 4.32. One major difference observed between dual and academic track concentrators was that 8.3% dual track participants indicated a blue-collar career in their career plans, while only 4.4% academic track participants indicated a similar plan.

One observation that was apparent between dual and occupational track participants was most of them were enrolled in public schools (98.0% for dual track and 98.8% for occupational track). The implications of dual track participants' characteristics and the comparison with other track participants will be discussed in Chapter 5.

Table 4.32

Dual and Academic Track Participants' Similar Student-level Characteristics Comparison

	Dual track	Academic track
Academic characteristics		
Mean GPA	3.16	3.30
Algebra 1 participation rate	98.6%	99.3%
Ever held back a grade	2.6%	2.8%
School-sponsored activities participation		
School-sponsored activities participation rate	87.4%	91.5%
Post-secondary education plans		
2-year college	1.2%	0.7%
4-year college	91.4%	93.3%
Career plans		
White collar/professional/office	56.3%	58.4%
School level participation rate		
Urban area	30.0%	29.9%
Suburban area	52.2%	52.3%
Rural area	17.9%	17.8%

Note. Counts were weighted using student level normalized weights.

Research Question 1: Curriculum Tracks and Dropout Likelihood

Research question one was phrased "To what extent do high school students of various curriculum tracks differ in the likelihood of dropping out of high school, after controlling for major possible individual differences?" In answering this research question, a conceptual diagram was drawn to define each model based on student level and school level predictors, upon which a series of 2-level HGLM models were constructed using the HLM for Windows version 7.21p software to derive to the most parsimonious model that best explains the variation

in dropout likelihood among the American high school sophomore cohort of 2002. The conceptual diagram was constructed based on Tinto's (1975) mediation model, exploring the interaction between participants with academics and social systems of the school and this diagram can be found in Figure 2.1. First, the unconditional model was defined, followed by the baseline model that included student level independent variable, curriculum track, as the main predictor of dropout likelihood. The model was then expanded step by step, by including independent variables based on the conceptual diagram, one block at a time. Figure 4.1 illustrates the blocks of variables that were included sequentially to build the HGLM model, and Table 4.33 is a complete representation of all models that were constructed.

The HGLM models constructed were random-intercept models because the variation of slopes for all predictor variables was found to be insignificant. Thus, as suggested by Raudenbush and Bryk (2002), the variance of residuals, u_{1j}, is constrained to 0.

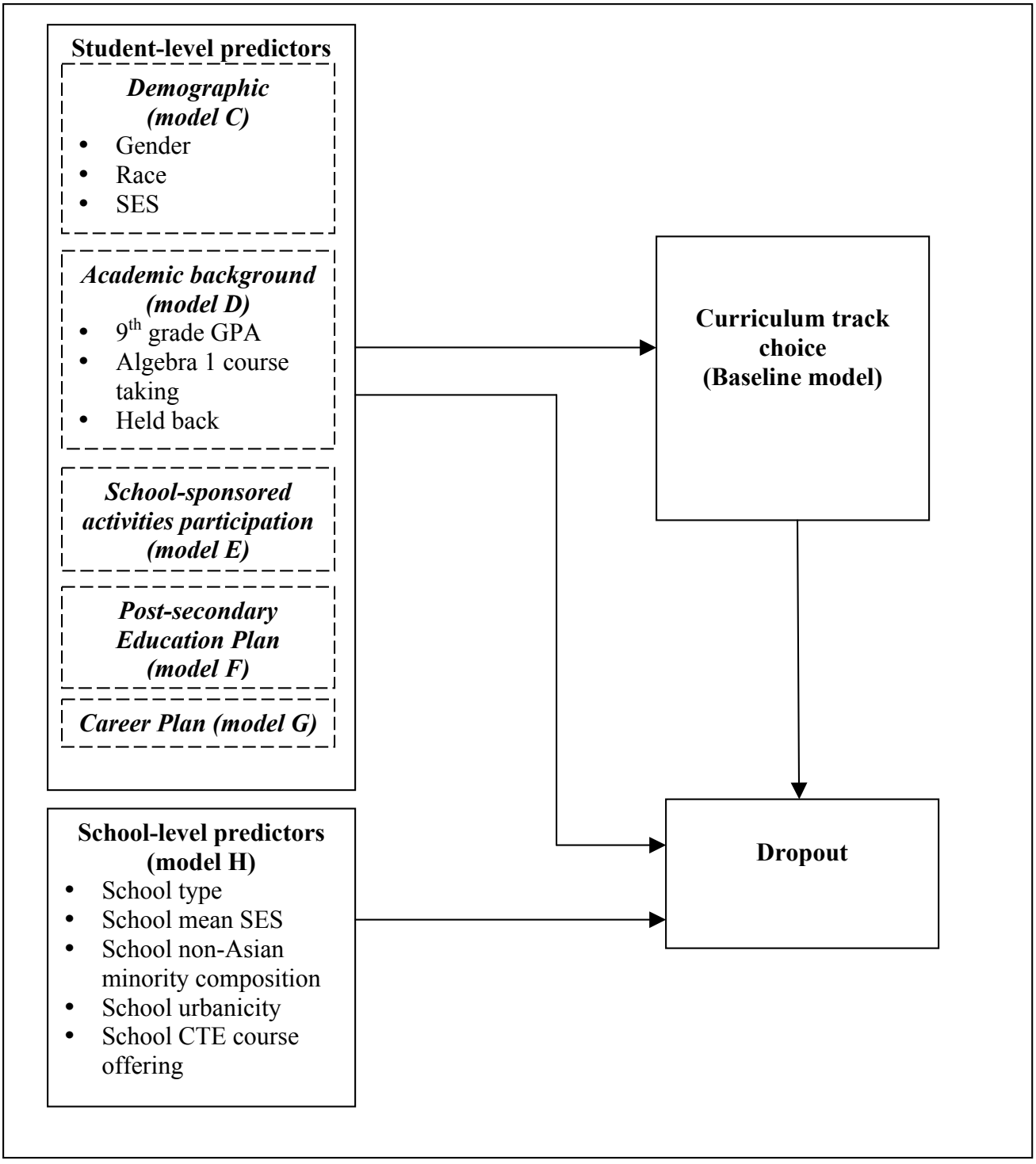

Figure 4.1. **HGLM Model-building Conceptual Diagram.**

Table 4.33

Research Question 1: Model Comparison Summary (Unit Specific)

Parameters	**Model A** (unconditional)	**Model B** (baseline)	**Model C** (+demographic)	**Model D** (+academic)	**Model E** (+extracurr)	**Model F** (+education plan)	**Model G** (+career plan)	**Model H** (-career plan, +level2)	**Model I** (final model)
Fixed Effects – Level 1 predictors									
Intercept	-2.852*** (0.061)	-2.314*** (0.060)	-2.249*** (0.081)	1.073*** (0.190)	1.372*** (0.194)	0.957*** (0.208)	0.950*** (0.217)	-2.190** (0.245)	-2.036*** (0.170)
Academic track		-4.947*** (0.580)	-4.570*** (0.581)	-3.578*** (0.584)	-3.462*** (0.584)	-3.415*** (0.584)	-3.419*** (0.584)	-3.339*** (0.585)	-3.350*** (0.585)
Occupational track		-1.054*** (0.134)	-1.175*** (0.134)	-1.206*** (0.141)	-1.275*** (0.143)	-1.323*** (0.145)	-1.326*** (0.145)	-1.349*** (0.144)	-1.348*** (0.144)
Female			-0.464*** (0.0793)	-0.185* (0.085)	-0.206** (0.086)	-0.153 (0.087)	-0.160 (0.088)	-0.156 (0.087)	-0.158 (0.087)
Race – Asian			-0.858*** (0.207)	-0.576** (0.217)	-0.597** (0.219)	-0.545* (0.220)	-0.536* (0.220)	-0.622** (0.224)	-0.581** (0.219)
Race – Black			0.216 (0.118)	-0.264* (0.127)	-0.148 (0.128)	-0.095 (0.129)	-0.089 (0.130)	-0.171 (0.143)	-0.111 (0.129)
Race – Hispanic			0.179 (0.118)	-0.043 (0.124)	-0.011 (0.126)	0.020 (0.126)	0.032 (0.127)	-0.078 (0.144)	0.004 (0.126)
Race – Others			0.650*** (0.146)	0.509** (0.157)	0.565*** (0.159)	0.607*** (0.160)	0.610*** (0.160)	0.561*** (0.164)	0.595*** (0.160)
SES, continuous			-0.773*** (0.066)	-0.460*** (0.072)	-0.389*** (0.073)	-0.333*** (0.073)	-0.333*** (0.074)	-0.254** (0.079)	-0.290*** (0.074)
9th grade GPA				-1.246*** (0.063)	-1.152*** (0.064)	-1.098*** (0.064)	-1.100*** (0.064)	-1.080*** (0.064)	-1.082*** (0.064)
Took Algebra 1				-0.743*** (0.128)	-0.622*** (0.130)	-0.546*** (0.131)	-0.550*** (0.131)	-0.527*** (0.131)	-0.518*** (0.130)
				0.730*** (0.111)	0.685*** (0.112)	0.630*** (0.113)	0.634*** (0.114)	0.619*** (0.113)	0.629*** (0.113)
Held back non-respondent				0.414*** (0.105)	0.364*** (0.106)	0.327** (0.107)	0.323** (0.107)	0.329** (0.107)	0.334** (0.107)
School-sponsored act. participation					-0.979*** (0.088)	-0.906*** (0.089)	-0.906*** (0.089)	-0.887*** (0.089)	-0.884*** (0.089)

Table 4.33 continued

Parameters	Model A (unconditional)	Model B (baseline)	Model C (+demographic)	Model D (+academic)	Model E (+extracurr)	Model F (+education plan)	Model G (+career plan)	Model H (-career plan, +level2)	Model I (final model)
No education plan						0.318**	0.325**	0.311**	0.308*
						(0.119)	(0.121)	(0.119)	(0.119)
Plans to graduate HS or obtain GED						0.825***	0.838***	0.809***	0.806***
						(0.127)	(0.130)	(0.127)	(0.127)
Plans to enroll in 2-year college						0.325*	0.318*	0.318*	0.311*
						(0.146)	(0.148)	(0.146)	(0.146)
Career plan non-respondent							-0.016		
							(0.136)		
Career plan: blue-collar							0.080		
							(0.146)		
Career plan: White collar							0.033		
							(0.107)		
Career plan: Military							-0.138		
							(0.255)		
Career plan: Unclassified							-0.562		
							(0.611)		
Fixed Effects: Level 2 predictors									
Private school								-0.442*	-0.592***
								(0.213)	(0.178)
School mean SES								-0.239	
								(0.192)	
Non-Asian minority %								0.092	
								(0.242)	
Table 4.33 continued								0.058	
								(0.128)	
Rural area								0.093	
								(0.139)	
CTE offer: Non-respondent								0.322	
								(0.218)	
School offers CTE								0.107	

Parameters	**Model A** (unconditional)	**Model B** (baseline)	**Model C** (+demographic)	**Model D** (+academic)	**Model E** (+extracurr)	**Model F** (+education plan)	**Model G** (+career plan)	**Model H** (-career plan, +level2)	**Model I** (final model)
								(0.185)	
Variance Components									
Level-2 intercept	0.773*** (0.109)	0.678*** (0.103)	0.512*** (0.090)	0.502*** (0.098)	0.502*** (0.100)	0.482*** (0.099)	0.484*** (0.100)	0.446*** (0.097)	0.461*** (0.098)
Goodness-of-fit									
Pseudo R^2		0.123	0.338	0.351	0.351	0.376	0.374	0.423	0.404
#parameters	2	4	10	14	15	18	23	25	19
Deviance	27193.676	26629.593	26390.422	25727.509	25602.338	25560.590	25558.791	25541.793	25548.709
AIC	27197.676	26637.593	26410.422	25755.509	25632.338	25596.590	25604.791	25591.793	25586.013
BIC	27212.396	26667.032	26484.020	25858.546	25742.735	25729.066	25774.066	25775.788	25726.545
Deviance test									
Models compared		A against B	B against C	C against D	D against E	E against F	F against G	F against H	I against H
χ^2		564.083***	239.171***	662.913***	125.171***	41.748***	1.799	18.797**	6.916

***(p<0.001); **(p<0.01); *(p<0.05). Standard errors in parenthesis.
Note 1. HGLM was performed via Full Maximum Likelihood with Adaptive Gaussian Quadrature.
Note 2. All analyses were conducted using the student level normalized weights.
Note 3. Sample size (n) was 11,612 for BIC calculation.

Unconditional model (Model A). The unconditional model was built to investigate the predicted average log-odds of dropout episode of the 2002 sophomore cohort. The unconditional model was specified as follows:

Level-1 model: $\eta_{ij} = \beta_{0j}$

where η_{ij} : log-odds (i.e. logit) that student i in school j drops out of high school,

β_{0j}:mean dropout likelihood in logit scale for school *j*.

Level-2 model: $\beta_{0j} = \gamma_{00} + u_{0j};\ u_{0j} \sim N(0, \tau_{00})$

where γ_{00} : overall average log-odds of dropout episode across schools,

u_{0j}: the unique effect of school *j* and it is assumed to be normally distributed as mean is 0 and variance is τ_{00}.

The unit-specific model results obtained revealed expected dropout log-odds of -2.852 that translates to an expected probability of 0.055. In other words, the finding suggests that a typical high school student has a 5.5% probability of dropping out of high school. The population average model resulted in an expected dropout log-odds of -2.212, or a probability of 0.099. This finding translates to an average dropout rate of 9.9% across schools, and this estimate is close to a descriptive estimate of 9.5% dropout rate when dual track participants were excluded from the analysis. Summary of the unconditional model results can be found in Table 4.34. Findings from the variance component of the unconditional unit-specific model reflect significant variability in log-odds of dropout likelihood among high schools ($\tau_{00} = 0.773$, $p<0.001$).

Table 4.34
Unconditional Model Unit-Specific and Population Average Results

Variable	Unit specific model			Population Average Model		
	Coefficient	Odds Ratio	95% C.I.	Coefficient	Odds Ratio	95% C.I.
Intercept	-2.852***	0.058	0.051, 0.065	-2.212***	0.109	0.098, 0.123

***$p<0.001$

Baseline model (Model B). The main predictor for research question 1 is curriculum track choices, namely general, academic, dual, and occupational tracks. Since dual track had 0% dropout rate and was excluded from the HGLM analysis, the baseline model included two dummy variables, dAcademic and dOccupational, representing academic and occupational tracks. The two tracks were compared with the general track that was designated as the reference group. The baseline model was specified as follows:

Level-1 model: $\eta_{ij} = \beta_{0j} + \beta_{1j}*(DACADEMIC_{ij}) + \beta_{2j}*(DOCCUPATIONAL_{ij})$

where η_{ij} : log-odds (i.e. logit) that student i in school j drops out of high school,

β_{0j}: school mean dropout likelihood in logit for general track participants in school*j*,

β_{1j}: average difference in logit of dropout likelihood for academic concentrators as compared to general track participants in school *j*, and

β_{2j}: average difference in logit of dropout likelihood for occupational concentrators in school *j*.

Level-2 model:

$\beta_{0j} = \gamma_{00} + u_{0j};\ u_{0j} \sim N(0, \tau_{00})$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

where γ_{00} : average dropout likelihood in logit for general track participants across schools,

γ_{10} :average difference in dropout likelihood in logit for academic concentrators as compared to general track participants across schools,

γ_{20} :average difference in dropout likelihood in logit for occupational concentrators as compared to general track participants across schools.

u_{0j}: unique effect of school *j* after controlling for participant curriculum track membership and it is assumed to be normally distributed as mean is 0 and variance is τ_{00}.

Note that since the random effects associated with β_{1j} and β_{2j}, namely $u_{1j}$and u_{2j}, were not statistically significant by deviance test ($\chi^2_{obs} = 2.793$, $p>0.05$), they were dropped from the model and therefore β_{1j} and β_{2j}were fixed.

From the Pseudo R^2 value of 0.123 obtained, 12.3% of level-2 intercept variance, which is the between school variance of dropout rate, was explained by adding curriculum track dummy variables to the model. The unit-specific model results obtained suggested general track participants had dropout average log-odds of -2.314 or a 0.899 probability of dropping out of high school. It was also found that academic and dual concentrators were significantly less likely to drop out than general track participants where academic concentrators' coefficient, γ_{10}=-4.947, $t(10,876)$=-8.524, $p<0.001$ and occupational concentrators' coefficient,γ_{20}=-1.054, t_{obs}=-7.888, $p<0.001$.The comparison between unit-specific and population-average models can be found in Table 4.35. The odds ratio values for both academic and occupational tracks in the unit-specific and population average models reflect that both curriculum track concentrators were substantially less likely to drop out than their general track counterparts. Findings from the

variance component of baseline unit-specific model reflect significant variability in log-odds of dropout likelihood among high schools ($\tau_{00} = 0.678$, $p<0.001$).

Table 4.35

Model B: Baseline Model Unit-Specific and Population Average Results

Variable	Unit specific model			Population Average Model		
	Coefficient	Odds Ratio	95% C.I.	Coefficient	Odds Ratio	95% C.I.
Intercept	-2.314***	0.099	0.088, 0.111	-1.790***	0.167	0.148, 0.188
Academic	-4.947***	0.007	0.002, 0.022	-4.769***	0.008	0.003, 0.027
Occupational	-1.054***	0.349	0.268, 0.453	-1.097***	0.334	0.248, 0.449

Note. ***$p<0.001$.

Significant level-1 predictors model (Model F). After all of the student-level (level-1) predictors were included in the model, career plan appeared to be an insignificant predictor of dropout likelihood among the 2002 high school sophomore cohort. None of the dummy variables related to career plan showed statistical significance hence this variable was dropped from the model. Model F represents the HGLM model with significant level-1 predictors, before level-2 variables were included in the analysis. Significant level-1 predictors are race, SES, 9th grade GPA, Algebra 1 course taking, being held back at least a grade in school, school-sponsored activities participation, and post-secondary education plans. Gender appeared to be a statistically insignificant predictor after all other level-1 predictors were controlled for, but is still included in the model.

All categorical and dummy variables in this model were uncentered while continuous variables F1SES2 (student SES) and F1RGP9 (student 9th grade GPA) were grand mean centered. The reference group for this model has the following characteristics:

1. follow the general curriculum track
2. males
3. Whites
4. average SES (mean)
5. average GPA (mean)
6. did not take Algebra 1
7. never held back a grade in school
8. did not participate in school-sponsored activities
9. planned to enroll in 4-year college

The unit-specific model results from the HGLM analysis via AGQ revealed that the reference group's coefficient of dropping out of high school is 0.957, which translates to a 0.723 in odds ratio of dropping out for a White male participant who followed the general track, with average SES and 9th grade GPA, did not take Algebra 1, was never held back a grade in school, did not participate in school-sponsored activities, and planned to enroll in a 4-year college. Academic and dual concentrators were still significantly less likely to drop out than general track participants after controlling for level-1 predictors, where academic concentrators' coefficient, γ_{10}=-3.415, t_{obs}=--5.844, p<0.001 and occupational concentrators' coefficient, γ_{20}=-1.323, t_{obs}=-9.153, p<0.001. Asian participants were significantly less likely to drop out than White participants, while the race group "others" is significantly more likely to drop out than Whites at the .05 level. Both African American and Hispanic participants did not show any significant differences in dropout likelihood with White participants. SES is a significant indicator of dropout with a lower dropout probability among participants of higher SES [γ_{80}=-0.333, t_{obs}=-4.534, p<0.001].

One interesting observation was that the gender effect became statistically insignificant after post-secondary education plans were included in the model. Prior to including post-secondary education plans, female participants showed significantly lower dropout likelihood (refer to Table 4.33, Models C, D, and E). As such, a bivariate analysis was done on gender and post-secondary education plans, as shown in Table 4.36. From the results, more male than female participants indicated high school or GED and 2-year college as their post-secondary plans. More male participants also had no post-secondary plan indication. On the other hand, more female than male participants indicated 4-year college and postgraduate studies as their plan. The chi-square test of association statistic was significant at the $p<0.05$ level. Recalling Table 4.2, there appeared to be a higher participation rate in the academic and general tracks among female participants, while higher participation rates in the occupational and dual tracks were observed among male participants. The implications of these findings will be discussed in Chapter 5.

Academic background variables appeared to be significant predictors of dropout likelihood at the .05 level. Overall 9th grade GPA's statistic of γ_{90}=-1.098, t_{obs} =-17.122, $p<0.001$, indicates lower probability of dropping out of high school with higher GPA. Participants who had Algebra 1 in their high school course sequence are less likely to drop out than those who did not, and participants who were held back at least once during their schooling experience or were non-respondents to this question were more likely to dropout than participants who were never held back.

Table 4.36
Gender and Post-Secondary Education Plans Crosstabulation

			Gender		
			Male	Female	Total
Post-secondary education plans	No indication	Count	663	577	1240
		% within education plans	53.5%	46.5%	100.0%
		% within gender	11.2%	9.6%	10.4%
	High school/GED	Count	514	250	764
		% within education plans	67.3%	32.7%	100.0%
		% within gender	8.7%	4.2%	6.4%
	2-yr college	Count	456	316	772
		% within education plans	59.1%	40.9%	100.0%
		% within gender	7.7%	5.2%	6.5%
	4-yr college & postgraduate	Count	4276	4880	9156
		% within education plans	46.7%	53.3%	100.0%
		% within gender	72.4%	81.0%	76.7%
Total		Count	5909	6023	11932
		% within education plans	49.5%	50.5%	100.0%
		% within gender	100.0%	100.0%	100.0%

Note 1. $\chi^2_{obs}(df = 3) = 161.348$, $p<0.001$.
Note 2. Counts were weighted using student level normalized weights.

Students who participated at least one hour a week in school-sponsored activities were found to have a lower likelihood of dropping out than participants who did not participate at all. The statistic γ_{13}=-0.906, t_{obs}=-10.916, $p<0.001$ translates to 0.288 in probability, orthe expected odds of dropping out for participants who participated in school-sponsored activities are 0.404times the odds of those who did not participate.

Interestingly, post-secondary education plans has a significant influence on the likelihood of participants dropping out of high school. Participants who indicated 4-year college and postgraduate as their post-secondary destination were less likely to dropout than other

participants who indicated 2-year college, high school or GED, and who did not have any post-secondary education plans. The coefficients for all post-secondary education plan variables were significant at the .05 level.

Table 4.37 reflects the comparison between unit-specific and population-average results for Model F. From the results obtained, the coefficient and odds ratio values between the two models are very close. For example, the odds ratio for academic track concentrators was 0.033 in the unit-specific model, and 0.040 in the population-average model. In other words, academic track concentrators' expected odds of dropping out is 0.033 times the odds of dropping out for general track participants for the unit-specific model, and 0.040 times for the population-average model. Both models also suggest through the odds ratio obtained that occupational track concentrators were substantially less likely to dropout than general track participants.

One difference observed between the two models is the significance of gender in the likelihood of dropping out. The unit-specific model suggested that gender was an insignificant predictor of dropout, but population average model revealed that female participants were significantly less likely to dropout than male participants after controlling for other level-1 predictors at the $p<0.05$ level.

Table 4.37
Model F: Significant Level-1 Predictors Model, Unit-Specific and Population Average Results

Variable	Unit specific model			Population Average Model		
	Coefficient	Odds Ratio	95% C.I.	Coefficient	Odds Ratio	95% C.I.
Intercept	0.957***	2.604	1.732, 3.914	1.016***	2.762	1.759, 4.342
Curriculum track						
Academic track	-3.415***	0.033	0.010, 0.103	-3.208***	0.040	0.012,0.141
Occupational track	-1.323***	0.266	0.200, 0.354	-1.265***	0.282	0.207,0.385
Demographic						
Female	-0.153	0.858	0.724, 1.018	-0.247*	0.781	0.644,0.948
Race: Asian	-0.545*	0.580	0.377, 0.892	-0.492*	0.611	0.377,0.993
Race: African American	-0.095	0.909	0.706, 1.171	-0.041	0.960	0.720,1.278
Race: Hispanic	0.020	1.020	0.797, 1.306	-0.018	0.982	0.744,1.297
Race: Others	0.607***	1.835	1.341, 2.511	0.427*	1.533	1.074,2.187
SES	-0.333***	0.717	0.621, 0.827	-0.326***	0.722	0.611,0.852
Academic background						
9th grade GPA	-1.098***	0.334	0.294, 0.378	-1.015***	0.362	0.316,0.416
Took Algebra 1	-0.546***	0.579	0.488, 0.749	-0.431**	0.650	0.490,0.861
Held back no response	0.327**	1.387	1.124, 1.710	0.372**	1.451	1.143,1.843
Held back at least once	0.630***	1.878	1.505, 2.343	0.622***	1.863	0.959,1.627
School-sponsored act.	-0.906***	0.404	0.339, 0.481	-0.893***	0.409	0.336,0.498
Post-secondary education plan						
None	0.318**	1.374	1.088, 1.735	0.223	1.250	0.959,1.627
High school/GED	0.825***	2.282	1.779, 2.927	0.705***	2.024	1.533,2.673
2-year college	0.325*	1.384	1.036, 1.850	0.300	1.350	0.973,1.874

Note. *p<0.05, **p<0.01, ***p<0.001

From the Pseudo R^2 value of 0.376 obtained for Model F, 37.6% of level-2 intercept variance, which is the between school variance of dropout rate, was explained by including significant level-1 predictors in the model. This value suggested a 62.4% unexplained variance that might be caused by other factors not included in the analysis.

Final model (Model I). The final HGLM model, Model I, derived in this study includes significant level-1 predictors as in Model F, and one level-2 predictor, school type. All other school level predictors were found to be insignificant when they were included in the HGLM analysis and the results are shown in Table 4.33 (refer to Model H). Private school participants were significantly less likely to drop out of school than public school participants, as suggested by the model [γ_{17}=-0.592, t_{obs} =-3.331, p<0.001]. In other words, the probability of 0.356 indicates that private school participants had an expected odds of dropping out that was 0.553 times than their public school counterparts. Both dummy variables for curriculum track still showed statistical significance in influencing dropout likelihood where academic and occupational concentrators were less likely to dropout than general track participants.

Two continuous predictors in this model, 9th grade GPA and SES, consistently showed statistical significance at the p<0.001 level. Figures 4.2 and 4.3 portray the effect these two variables have on dropout likelihood. The graphs were produced by fixing all other predictors at grand-mean (grand-mean centered), and keeping the variable of interest (9th grade GPA and SES, respectively) uncentered.

In Figure 4.2, it is illustrated that dropout likelihood decreases as SES increases, where γ_{80}=-0.290, *ceteris paribus* in the unit-specific model. From the odds ratio value in Table 4.38, two similar participants who differ by one SES standard deviation (sd = 0.717), the relative odds

of dropping out for the student with higher SES is expected to be 0.536 times the odds of dropping out for the student with lower SES.

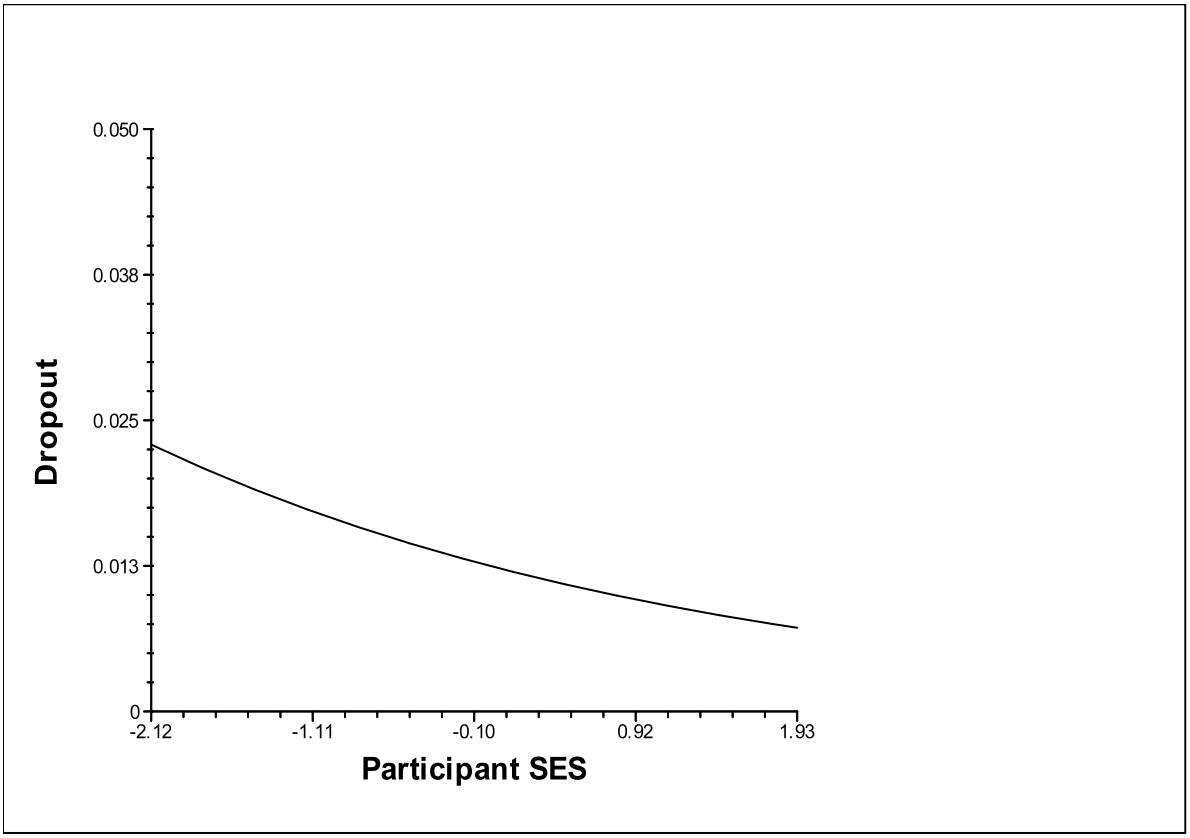

Figure 4.2. **SES and Dropout Likelihood, Ceteris Paribus**

Similar to SES, 9th grade overall GPA is observed to be associated with lower dropout likelihood where γ_{80}=-1.098, *ceteris paribus*in the unit-specific model. Figure 4.3 illustrates this relationship. One GPA unit differs by one standard deviation (*sd* = 0.840). Comparing two similar participants whose GPAs differ by one standard deviation, the relative odds of dropping out for the student with higher GPA is expected to be 0.280 times the odds of dropping out for the student with lower GPA.

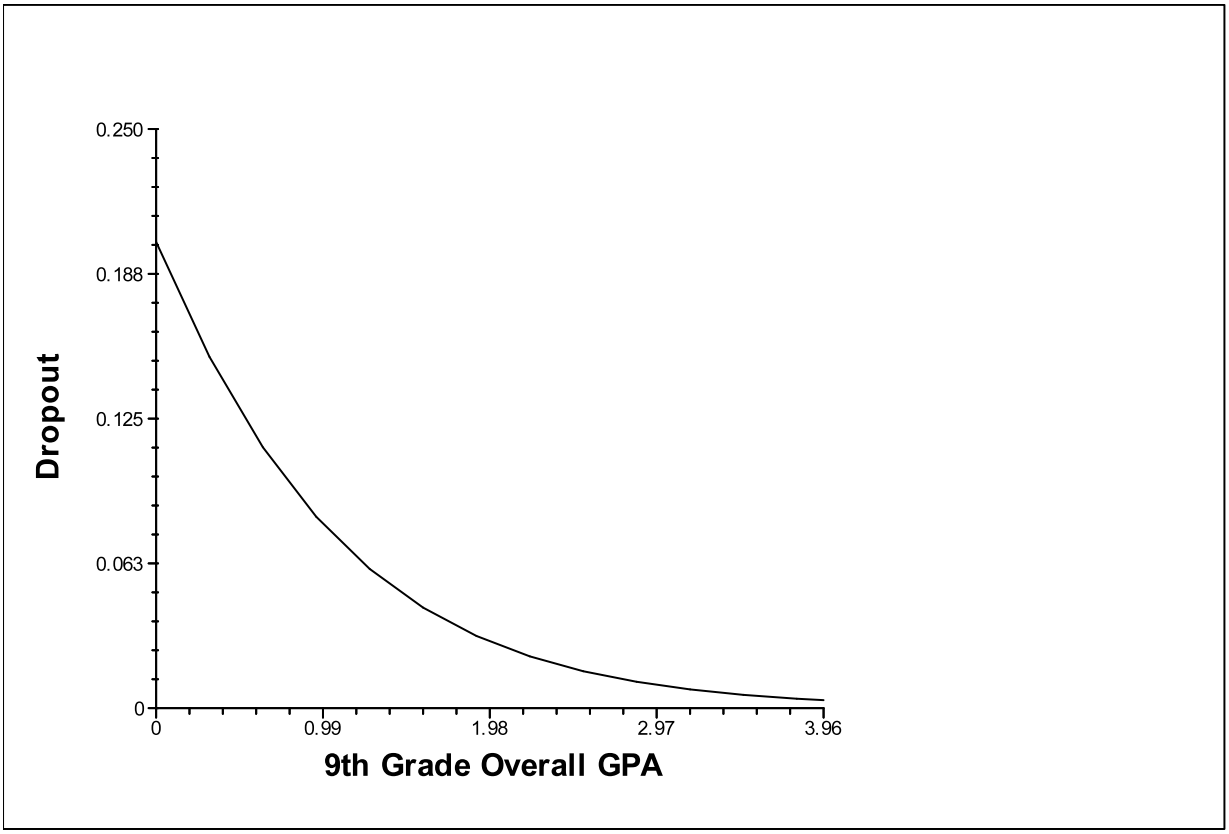

Figure 4.3. **9th Grade Overall GPA and Dropout Likelihood, Ceteris Paribus**

The unit-specific final model suggested that a White male participant who went to a public school, followed the general track, with average SES and 9th grade GPA, did not take Algebra 1, was never held back a grade in school, did not participate in school-sponsored activities, and planned to enroll in a 4-year college had a probability of 0.115 of dropping out of high school, or an 11.5% chance of dropping out.

Table 4.38 reflects the unit-specific and population-average models coefficients and odds ratio. The population-average model suggests a dropout probability of 0.140 among the reference group, slightly higher than unit-specific model's 0.115. The probability derived for both models were similar for all predictors.

Table 4.38

Model I: Unit-Specific and Population-Average Models Coefficients and Odds Ratio

Variables	Unit-specific Model			Population-average Model		
	Log-odds, γ_{q0}	Odds ratio	95% C.I.	Log-odds, γ_{q0}	Odds ratio	95% C.I.
Intercept	-2.036***	0.131	0.094, 0.182	-1.813***	0.163	0.113, 0.235
Academic track	-3.350***	0.035	0.011, 0.110	-3.186***	0.041	0.012, 0.141
Occupational track	-1.348***	0.260	0.196, 0.345	-1.270***	0.281	0.206, 0.382
Female	-0.158	0.854	0.720, 1.013	-0.245	0.783	0.647, 0.948
Race: Asian	-0.581**	0.559	0.364, 0.860	-0.491*	0.612	0.378, 0.990
Race: African American	-0.111	0.895	0.695, 1.152	-0.046	0.955	0.719, 1.268
Race: Hispanic	0.004	1.004	0.785, 1.284	-0.020	0.980	0.744, 1.291
Race: Others	0.595***	1.813	1.326, 2.479	0.429*	1.536	1.080, 2.185
SES	-0.290***	0.748	0.647, 0.866	-0.317***	0.728	0.617, 0.859
9^{th} grade GPA	-1.082***	0.339	0.299, 0.384	-1.011***	0.364	0.318, 0.417
Took Algebra 1	-0.518***	0.596	0.461, 0.769	-0.429**	0.651	0.492, 0.862
Held back non-respondent	0.334**	1.397	1.133, 1.722	0.372**	1.451	1.145, 1.838
Held back at least once	0.629***	1.876	1.503, 2.342	0.623***	1.865	1.454, 2.392
School-sponsored act. part.	-0.884***	0.413	0.347, 0.492	-0.889***	0.411	0.338, 0.499
Post-sec. plan: None	0.308*	1.361	1.078, 1.717	0.222	1.249	0.961, 1.622
Post-sec. plan: HS/GED	0.806***	2.239	1.745, 2.873	0.706***	2.026	1.537, 2.670
Post-sec. plan: 2-yr college	0.311*	1.365	1.026, 1.816	0.299	1.349	0.975, 1.865
Private school	-0.592***	0.553	0.390, 0.784	-0.328	0.720	0.487, 1.065

Note. *p<0.05, **p<0.01, ***p<0.001

The value of Pseudo R^2 for the unit-specific model obtained was 0.404, indicating 40.4% of between school dropout rate variance was explained by including curriculum track, demographic variables, school-sponsored activity participation, post-secondary education plans, and school type to the model. This implies another 59.6% unexplained variance might be caused by other factors that were not included in the study.

Summary. Research question 1 focused on curriculum track choice's influence on dropout likelihood. It was found from the series of analyses conducted via HGLM that curriculum track choice indeed has an impact on dropout likelihood, where academic and occupational concentrators were found to be significantly less likely to dropout than general track participants after controlling for other level-1 predictors, except career plans. Career plans was found to be an insignificant predictor of dropout likelihood and was therefore dropped from the final model. Only one level-2 predictor was found to be significant in predicting dropout likelihood, namely school type. This will be further discussed in the next section.

The HGLM model did not include dual track concentrators because it was found in the descriptive analysis that no one from the dual track dropped out. This caused a negative infinity logit, and the comparison between dual track concentrators and other participants was not possible via HGLM.

Interaction term between race and SES mentioned in the literature that appears to have an influence on dropouts was explored, but was found to be insignificant in this study. Therefore, no interaction terms were included in the model.

Research Question 2: School-level Predictors and Dropout Likelihood

The next research question, "How do institutional factors related to curriculum track (such as minority composition, level of neighborhood poverty, available funding, and CTE courses offered) associate with the likelihood of students dropping out of high school?", focuses on school-level predictors that were found to have significant impact on dropout likelihood. From the HGLM analysis conducted, it was found that only school type was significant in predicting dropout likelihood among the 2002 high school sophomore cohort.

This study examined school type (public or private school), school mean SES, school non-Asian minority composition, school urbanicity (rural, suburban, or urban), and CTE course offering in relation to dropout likelihood. HGLM Model H was constructed to include all the level-2 predictors, and it was found that only school type was significant [γ_{01}=-0.442, t_{obs} = -0.665, p<0.001] in predicting dropout likelihood.

In the final model, Model I, dummy variable for private school's coefficient was found to be γ_{01}=-0.592, and this translates to an odds ratio of 0.553. In other words, the expected odds of dropping out of participants who went to private schools are 0.553 times the odds of dropping out among public school participants, *ceteris paribus*. This statistic suggests lower odds for students attending private schools to drop out as compared to their public school counterparts.

Part 2: CTE Program Areas and Dropout Likelihood

Research question 3 aims to dissect different career and technical education (CTE) program areas in terms of dropout likelihood. The research question was phrased "How do different career and technical education areas differ in the likelihood of dropping out of high school?". In answering this research question, the crucial descriptive statistic outcomes are presented first, followed by the HGLM modeling to predict dropout likelihood among the different CTE areas. In chapter 3, seven CTE program areas were identified, namely Agriculture, Food, and Natural Resources Education (Agriculture area); Business, Marketing, Information Technology, and Computer Science (Business area); Family and Consumer Sciences (FCS), Human Services, Public Services, Health Science, and Education (Human Services area); Trade and Industrial (Trade and Industrial area); Technology Education area, General Career Development and Work Experience (Career area), and 2 or more CTE areas. All analyses were conducted using new normalized weight based on the new subsample of occupational concentrators. The weights were still derived from the second follow up transcript weight, F2QTSCWT.

CTE Program Areas Descriptive Analyses

Earlier in chapter 3, Table 3.7 represented the crosstabulation between CTE program areas and their respective dropout statistic. The highest dropout rate was among participants in the FCS area (9.6%), and the lowest was among participants in the Technology Education area (1.7%). The chi square test of association statistic was found to be $\chi^2_{obs}(df = 6) = 16.678$, $p<0.05$, suggesting there are statistically significant differences between the CTE areas in terms of dropout likelihood.

Demographic: Gender. From Table 4.39, significant differences between male and female participants were observed in the CTE program area enrollment patterns. The enrollment rates were higher for male participants in Agriculture, Trade and Industrial, Technology Education, and Career areas. Differences between dropout rates of male and female occupational concentrators were observed to be significant via chi-square test of association where $\chi^2_{obs}(df = 1) = 7.838$, $p<0.05$. Males had a higher dropout rate of 6.9% compared to females' 3.5%.

Demographic: Race. Descriptive analysis conducted to investigate the participation distribution of different race groups in different CTE areas revealed that Whites had the highest enrollment rate in Trade and Industrial (30.7%) while African Americans had the highest enrollment rate forBusiness/IT area. Hispanics were most likely to enroll in Trade and Industrial area with a participation rate of 27.8%. Asians had a 24.0% participation rate in the Business/IT and Trade and Industrial areas. The chi-square statistic appeared to be significant with $\chi^2_{obs}(df = 24) = 118.375$, $p<0.001$. The crosstabulation table is not presented in this study due to small cell size restrictions imposed by the National Center for Education Statistics (NCES) on restricted-use ELS dataset where any cells smaller than 3 must not be published or presented to unauthorized users (NCES, 2002).

Interestingly, among the occupational concentrators, the Asian race group had no dropouts. Therefore, the Asian race group was not included in the HGLM analysis as it will produce a negative infinity logit and comparison with other participants on the dropout likelihood is inconclusive. The highest dropout rate was observed for the African American race group (10.0%). Differences between the race groups were statistically significant as suggested by the chi square statistic which was significant at the $p<0.05$ level. The results can be found in Table 4.40.

Table 4.39

CTE Program Area and Gender Crosstabulation

			Gender		Total
			Male	Female	
CTE Program Area	Agriculture, Food, Natural Resources Education	Count	74	38	112
		% within CTE area	66.1%	33.9%	100.0%
		% within gender	8.0%	6.4%	7.4%
	Business, Marketing, Info Tech & Computer Science	Count	139	165	304
		% within CTE area	45.7%	54.3%	100.0%
		% within gender	15.0%	27.9%	20.1%
	Combination of 2 or more areas	Count	66	87	153
		% within CTE area	43.1%	56.9%	100.0%
		% within gender	7.1%	14.7%	10.1%
	FCS, Human Services, Public Services, Health & Education	Count	14	81	95
		% within CTE area	14.7%	85.3%	100.0%
		% within gender	1.5%	13.7%	6.3%
	General Career Development and Work Experience	Count	84	55	139
		% within CTE area	60.4%	39.6%	100.0%
		% within gender	9.1%	9.3%	9.2%
	Technology Education	Count	152	138	290
		% within CTE area	52.4%	47.6%	100.0%
		% within gender	16.5%	23.3%	19.1%
	Trade and Industrial	Count	395	28	423
		% within CTE area	93.4%	6.6%	100.0%
		% within gender	42.7%	4.7%	27.9%
Total		Count	924	592	1516
		% within CTE area	60.9%	39.1%	100.0%
		% within gender	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 6) = 332.300$, $p<0.001$.

Table 4.40
Occupational Concentrators: Race and Dropout Crosstabulation

			High School Dropout Status		
			Not Dropout	Dropout	Total
Race	African American	Count	198	22	220
		% within race	90.0%	10.0%	100.0%
		% within dropout	13.9%	25.3%	14.5%
	Asian	Count	24	0	24
		% within race	100.0%	.0%	100.0%
		% within dropout	1.7%	.0%	1.6%
	Hispanic	Count	186	9	195
		% within race	95.4%	4.6%	100.0%
		% within dropout	13.0%	10.3%	12.9%
	Others	Count	74	7	81
		% within race	91.4%	8.6%	100.0%
		% within dropout	5.2%	8.0%	5.3%
	White	Count	947	49	996
		% within race	95.1%	4.9%	100.0%
		% within dropout	66.3%	56.3%	65.7%
Total		Count	1429	87	1516
		% within race	94.3%	5.7%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 4) = 11.798$, $p<0.05$.

Demographic: SES. SES means comparison between the different CTE program areas is presented in Table 4.41. From the results shown, Technology Education area had the highest mean SES of -0.078 while participants in the Agriculture area had the lowest mean SES of -0.116. ANOVA was conducted to further investigate the differences and it was found via Tukey HSD post-hoc statistics that the mean SES for Technology Education area participants was significantly higher than participants in the Agriculture area. ANOVA results were significant at the $p<0.05$ level.

Table 4.41

CTE Program Area and SES Means Comparison

CTE Program Area	Mean	N	Std. Deviation
Agriculture, Food, Natural Resources Education	-0.321	112	0.573
Business, Marketing, Info Tech & Computer Science	-0.209	304	0.629
Combination of 2 or more areas	-0.116	153	0.626
FCS, Human Services, Public Services, Health & Education	-0.230	94	0.505
General Career Development & Work Experience	-0.254	140	0.593
Technology Education	-0.078	290	0.599
Trade and Industrial	-0.241	423	0.572
Total	-0.197	1515	0.596

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $F_{obs}(df_1 = 6, df_2=1,508) = 3.912$, $p<0.01$.

The occupational concentrator dropouts differ from non-dropouts in their mean SES. As suggested by the results in Table 4.42, non-dropouts had significantly higher SES mean than the dropouts at the $p<0.05$ level.

Table 4.42

Occupational Concentrators and Dropout SES Means Comparison

High School Dropout Status	Mean	N	Std. Deviation
Not Dropout	-.1885	1429	.59817
Dropout	-.3439	86	.54698
Total	-.1973	1515	.59631

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $F_{obs}(df_1 = 1, df_2=1,513) = 5.513$, $p<0.05$.

Academic background: 9th grade overall GPA. Occupational concentrators have a mean GPA of 2.50 as suggested by the descriptive findings in Table 4.43. It was also observed that participants in the Technology Education area had the highest mean GPA of 2.69 while

participants in the Trade and Industrial area had the lowest mean GPA of 2.33. The ANOVA analysis with Tukey HSD post-hoc conducted revealed that the Trade and Industrial area participants had significantly lower 9th grade overall GPA mean at the $p<0.05$ level than the following area participants:(a) Business area**,** (b) Agriculture area, and (c) Technology Education area. Significantly higher mean GPA at the $p<0.05$ level was also observed among Technology Education area participants when compared with Career and 2 or more CTE area participants.

Comparing the 9th grade overall GPA of occupational concentrator dropouts and non-dropouts, significantly higher 9th grade GPA overall mean was observed among non-dropouts. Detailed results can be found in Table 4.44.

Table 4.43
Occupational Concentrators 9th Grade Overall GPA Means Comparison

CTE Program Area	Mean	N	Std. Deviation
Agriculture, Food, Natural Resources Education	2.67	112	0.738
Business, Marketing, Info Tech & Computer Science	2.57	304	0.750
Combination of 2 or more areas	2.41	153	0.749
FCS, Human Services, Public Services, Health & Education	2.52	94	0.704
General Career Development & Work Experience	2.40	140	0.731
Technology Education	2.69	290	0.711
Trade and Industrial	2.33	423	0.689
Total	2.50	1515	0.733

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $F_{obs}(df_1 = 6, df_2=1,508) = 5.155$, $p<0.001$.

Table 4.44

Dropouts and Non-dropouts 9th Grade Overall GPA Means Comparison

High School Dropout Status	Mean	N	Std. Deviation
Not Dropout	2.53	1429	.725
Dropout	1.95	86	.638
Total	2.50	1515	.733

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $F_{obs}(df_1 = 1, df_2=1,513) = 52.967$, $p<0.001$.

Academic background: Algebra 1 course taking. Overall, 90.9% of occupational concentrators took Algebra 1 during their schooling career, and the chi square statistic obtained suggested that there are differences between the different CTE program areas in terms of Algebra 1 course taking among participants. The lowest rate was observed for participants in the Career Prep area (79.1%) and the highest was among Business/IT area participants (96.7%). Detailed results can be found on Table 4.45. However, when the crosstabulation and chi-square analyses were conducted on dropouts, there appears to be no significant differences in Algebra 1 course taking between occupational concentrator dropouts and non-dropouts.

Academic background: Held back. Results from descriptive analysis in Table 4.46 revealed 13.8% of occupational concentrators have being held back a grade during their schooling career. Further investigation was conducted to find out if the differences between dropouts and non-dropouts among occupational concentrators in terms of being held back a grade was significant. From the results in Table 4.46, dropouts had a held back rate of 25.6%, significantly higher than non-dropouts (13.1% held back rate).

Table 4.45

CTE Program Areas and Algebra 1 Course Taking Crosstabulation

			Algebra 1 coursetaking		Total
			No	Yes	
CTE Program Area	Agriculture, Food, Natural Resources Education	Count	4	107	111
		% within CTE	3.6%	96.4%	100.0%
		% within Algebra 1	2.9%	7.8%	7.3%
	Business, Marketing, Info Tech & Computer Science	Count	10	294	304
		% within CTE	3.3%	96.7%	100.0%
		% within Algebra 1	7.2%	21.3%	20.1%
	Combination of 2 or more areas	Count	16	137	153
		% within CTE	10.5%	89.5%	100.0%
		% within Algebra 1	11.6%	9.9%	10.1%
	FCS, Human Services, Public Services, Health & Education	Count	4	91	95
		% within CTE	4.2%	95.8%	100.0%
		% within Algebra 1	2.9%	6.6%	6.3%
	General Career Development & Work Experience	Count	29	110	139
		% within CTE	20.9%	79.1%	100.0%
		% within Algebra 1	21.0%	8.0%	9.2%
	Technology Education	Count	25	265	290
		% within CTE	8.6%	91.4%	100.0%
		% within Algebra 1	18.1%	19.2%	19.1%
	Trade and Industrial	Count	50	374	424
		% within CTE	11.8%	88.2%	100.0%
		% within Algebra 1	36.2%	27.1%	28.0%
Total		Count	138	1378	1516
		% within CTE	9.1%	90.9%	100.0%
		% within Algebra 1	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 6) = 46.548$, $p<0.05$.

Table 4.46

Occupational Concentrator Dropouts and Held Back Crosstabulation

			Ever Held Back a Grade			Total
			Non-respondent	No	Yes	
High School Dropout Status	Not Dropout	Count	250	992	187	1429
		% within dropout	17.5%	69.4%	13.1%	100.0%
		% within held back	93.6%	95.5%	89.5%	94.3%
	Dropout	Count	17	47	22	86
		% within dropout	19.8%	54.7%	25.6%	100.0%
		% within held back	6.4%	4.5%	10.5%	5.7%
Total		Count	267	1039	209	1515
		% within dropout	17.6%	68.6%	13.8%	100.0%
		% within held back	100.0%	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df=2) = 11.998$, $p<0.01$.

Table 4.47 shows the differences between the program areas and held back rates were found to be significant at the $p<0.05$ level where participants from the Agriculture area had the highest held back rate of 19.8%. The lowest rate was observed among FCS area participants (8.5%).

Table 4.47

CTE Program Area and Held Back Crosstabulation

			Ever Held Back a Grade			
			Non-respondent	No	Yes	Total
CTE Program Area	Agriculture, Food, Natural Resources Education	Count	13	76	22	111
		% within CTE	11.7%	68.5%	19.8%	100.0%
		% within held back	4.9%	7.3%	10.6%	7.3%
	Business, Marketing, Info Tech & Computer Science	Count	59	212	32	303
		% within CTE	19.5%	70.0%	10.6%	100.0%
		% within held back	22.1%	20.4%	15.4%	20.0%
	Combination of 2 or more areas	Count	24	104	25	153
		% within CTE	15.7%	68.0%	16.3%	100.0%
		% withinheld back	9.0%	10.0%	12.0%	10.1%
	FCS, Human Services, Public Services, Health & Education	Count	21	65	8	94
		% within CTE	22.3%	69.1%	8.5%	100.0%
		% within held back	7.9%	6.3%	3.8%	6.2%
	General Career Development & Work Experience	Count	36	83	21	140
		% within CTE	25.7%	59.3%	15.0%	100.0%
		% within held back	13.5%	8.0%	10.1%	9.2%
	Technology Education	Count	47	215	28	290
		% within CTE	16.2%	74.1%	9.7%	100.0%
		% withinheld back	17.6%	20.7%	13.5%	19.2%
	Trade and Industrial	Count	67	284	72	423
		% within CTE	15.8%	67.1%	17.0%	100.0%
		% withinheld back	25.1%	27.3%	34.6%	27.9%
Total		Count	267	1039	208	1514
		% within CTE	17.6%	68.6%	13.7%	100.0%
		% withinheld back	100.0%	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 12) = 28.719$, $p<0.05$.

School-sponsored activities participation. Among occupational concentrators, 67.7% participation rate was observed in school-sponsored activities. Dropouts had a lower participation rate of 38.4% as compared to non-dropouts (69.4%). The difference between

dropouts and non-dropouts in terms of school-sponsored activities participation rate was found to be statistically significant. Table 4.48 shows the results in detail.

Table 4.48

Occupational Concentrator Dropouts and School-sponsored Activities Participation

			HS Dropout Status		Total
			Not Dropout	Dropout	
Participation in school-sponsored activities	No participation	Count	437	53	490
		% within school-sponsored activities	89.2%	10.8%	100.0%
		% within dropout	30.6%	61.6%	32.3%
	Participated at least 1 hour a week	Count	992	33	1025
		% within school-sponsored activities	96.8%	3.2%	100.0%
		% within dropout	69.4%	38.4%	67.7%
Total		Count	1429	86	1515
		% within school-sponsored activities	94.3%	5.7%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df=1) = 35.733$, $p<0.001$.

Table 4.49 shows the crosstabulation between CTE program areas and school-sponsored activities participation. The results suggest significant differences in the participation rate between the various program area participants. 78.4% of Agriculture area participants were involved with school-sponsored activities, the highest participation rate among the program areas.

Table 4.49

CTE Program Areas and School-sponsored Activities Participation

			School-sponsored activities participation		
			No participation	At least 1 hour a week	Total
CTE Program Area	Agriculture, Food, Natural Resources Education	Count	24	87	111
		% within CTE	21.6%	78.4%	100.0%
		% within activities	4.9%	8.5%	7.3%
	Business, Marketing, Info Tech & Computer Science	Count	86	218	304
		% within CTE	28.3%	71.7%	100.0%
		% within activities	17.5%	21.3%	20.1%
	Combination of 2 or more areas	Count	56	97	153
		% within CTE	36.6%	63.4%	100.0%
		% within activities	11.4%	9.5%	10.1%
	FCS, Human Services, Public Services, Health & Education	Count	22	73	95
		% within CTE	23.2%	76.8%	100.0%
		% within activities	4.5%	7.1%	6.3%
	General Career Development & Work Experience	Count	62	78	140
		% within CTE	44.3%	55.7%	100.0%
		% within activities	12.6%	7.6%	9.2%
	Technology Education	Count	75	215	290
		% within CTE	25.9%	74.1%	100.0%
		% within activities	15.3%	21.0%	19.1%
	Trade and Industrial	Count	166	257	423
		% within CTE	39.2%	60.8%	100.0%
		% within activities	33.8%	25.1%	27.9%
Total		Count	491	1025	1516
		% within CTE	32.4%	67.6%	100.0%
		% within activities	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 6) = 36.912$, $p<0.001$.

Post-secondary education plan. Based on the chi-square test of association conducted between occupational concentrators and post-secondary education plans, there appears to be significant differences between dropouts and non-dropouts on their choices of post-secondary

destinations. Most of the dropouts (33.3%) indicated high school or GED as their plan while a majority (64.1%) of the non-dropouts indicated 4-year college or postgraduate studies. Detailed results are shown in Table 4.50.

Table 4.50
Dropout and Post-secondary Education Plan Crosstabulation

			HS Dropout Status		Total
			Not Dropout	Dropout	
Post-secondary education plans	No indication	Count	157	16	173
		% within education plans	90.8%	9.2%	100.0%
		% within dropout	11.0%	18.4%	11.4%
	High school/GED	Count	141	29	170
		% within education plans	82.9%	17.1%	100.0%
		% within dropout	9.9%	33.3%	11.2%
	2-yr college	Count	214	15	229
		% within education plans	93.4%	6.6%	100.0%
		% within dropout	15.0%	17.2%	15.1%
	4-yr college &postgrad	Count	916	27	943
		% within education plans	97.1%	2.9%	100.0%
		% within dropout	64.1%	31.0%	62.2%
Total		Count	1428	87	1515
		% within education plans	94.3%	5.7%	100.0%
		% within dropout	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df = 3) = 58.868$, $p<0.001$.

Table 4.51

CTE Program Area and Post-secondary Education Plan Crosstabulation

			Post-secondary Education Plans				
			No indication	High school/ GED	2-yr college	4-yr college & postgrad	Total
CTE Program Area	Agriculture, Food, Natural Resources Education	Count	20	8	20	65	113
		% within CTE	17.7%	7.1%	17.7%	57.5%	100.0%
		% within plans	11.6%	4.7%	8.7%	6.9%	7.5%
	Business, Marketing, Info Tech & Computer Science	Count	27	20	23	233	303
		% within CTE	8.9%	6.6%	7.6%	76.9%	100.0%
		% within plans	15.6%	11.8%	10.0%	24.7%	20.0%
	Combination of 2 or more areas	Count	26	14	19	94	153
		% within CTE	17.0%	9.2%	12.4%	61.4%	100.0%
		% within plans	15.0%	8.2%	8.3%	10.0%	10.1%
	FCS, Human Services, Public Services, Health & Education	Count	10	7	7	71	95
		% within CTE	10.5%	7.4%	7.4%	74.7%	100.0%
		% within plans	5.8%	4.1%	3.1%	7.5%	6.3%
	General Career Development & Work Experience	Count	14	15	26	84	139
		% within CTE	10.1%	10.8%	18.7%	60.4%	100.0%
		% within plans	8.1%	8.8%	11.4%	8.9%	9.2%
	Technology Education	Count	26	30	39	195	290
		% within CTE	9.0%	10.3%	13.4%	67.2%	100.0%
		% within plans	15.0%	17.6%	17.0%	20.7%	19.1%
	Trade and Industrial	Count	50	76	95	202	423
		% within CTE	11.8%	18.0%	22.5%	47.8%	100.0%
		% within plans	28.9%	44.7%	41.5%	21.4%	27.9%
Total		Count	173	170	229	944	1516
		% within CTE	11.4%	11.2%	15.1%	62.3%	100.0%
		% within plans	100.0%	100.0%	100.0%	100.0%	100.0%

Note 1. Normalized weights were recalculated based on the new subsample and were used in this analysis.
Note 2. $\chi^2_{obs}(df=18) = 100.281$, $p<0.001$.

In Table 4.51, different CTE program area participants indicate significantly different post-secondary education plans, as suggested by the chi-square statistic $\chi^2_{obs}(df=18) = 100.281$, $p<0.001$. For all program areas, majority of the participants indicated 4-year college or

postgraduate studies as their post-secondary education plan. 22.5% of Trade and Industrial program area participants indicated 2-year college as their plan, the highest percentage as compared to other program area participants who indicated the same plan.

Career plan. A crosstabulation was conducted between career plan and dropouts for occupational concentrators, but the table is not presented in this chapter due to NCES minimum cell size restriction. It was found that a majority of the occupational concentrators (46.9%) indicated white collar careers as their plans, but there was a large percentage (31.7%) of occupational concentrators indicated that they did not know what their careers at age 30 would be. The highest dropout rate was observed among participants who indicated homemaker/other category (16.7%) while non-respondents had the lowest dropout rate (3.5%). Differences between dropout and non-dropouts in their career plan was found to be statistically significant with the chi-square statistic $\chi^2_{obs}(df=5) = 16.371$, $p<0.01$.

Another crosstabulation was also conducted between career plan and the different CTE program areas, but the table is also not presented in this chapter due to NCES minimum cell size restriction. In Business, Human Services, and Technology Education program areas, a majority of the participants indicated white collar/professional/office as their career plan. Trade and Industrial, Agriculture, and Career area participants had a majority who indicated that they do not have any career projection for when they are 30 years old. Differences between different CTE program area participants in their career plan were found to be statistically significant with the chi-square statistic $\chi^2_{obs}(df=30) = 136.946$, $p<0.001$.

School level (Level-2) predictors. In this part of the study, school level predictors included were school type (public or private school), school mean SES, school non-Asian minority composition, school urbanicity, and CTE course offerings. There were a total of 443

schools and the unweighted descriptive of these level-2 predictors are presented in Table 4.52 (categorical variables) and Table 4.53 (continuous variables).

Table 4.52

School-level Predictors – Categorical

Variable	Categories	*n*	%
School type	Public school	415	93.7%
	Private school	28	6.3%
School urbanicity	Rural area	107	24.2%
	Suburban area	219	49.4%
	Urban area	117	26.4%
CTE course offering	Non-respondent	49	11.1%
	Offer CTE courses	358	80.8%
	Did not offer CTE courses	36	8.1%

Table 4.53

School-level Predictors – Continuous

	n	Minimum	Maximum	Mean	Std. Deviation
School mean SES	443	-1.45	1.39	-0.185	0.464
Non-Asian Minority Composition	443	0.00	1.00	0.352	0.400

HGLM Analysis. To answer research question 3, HGLM was used to construct models that explained the effects of participation in different CTE program areas on dropout likelihood, controlling for other possible individual differences as discussed earlier in Chapter 3. A conceptual diagram similar to Figure 4.1 was built, and used as a foundation to build the HGLM models. The conceptual diagram can be found in Figure 4.4. Although the diagram shows that there could be a mediation effect of CTE program area, HGLM is not able to test this effect, and

therefore treats CTE program area as an independent variable that is parallel to other predictors in the model. In other words, the effect of CTE program areas on dropout likelihood was determined after controlling for other possible individual differences. As mentioned earlier, it was found that there was a 0% dropout rate among Asian occupational concentrators. Therefore, this race group was not included in the HGLM analysis.

The summary of the models built is presented in Table 4.54. Key models are elaborated in the next section of this chapter. Interestingly, results obtained from the variance component of all unit-specific models built reflect insignificant variability in log-odds of dropout likelihood among high schools at the $p<0.05$ level. Although the absence of significance at the school-level variability might imply that linear regression models are adequate in explaining level-1 main effects on the likelihood of dropping out among occupational concentrators, the HGLM method is still employed due to the nested data structure of ELS. The implication of this finding will be further discussed in Chapter 5.

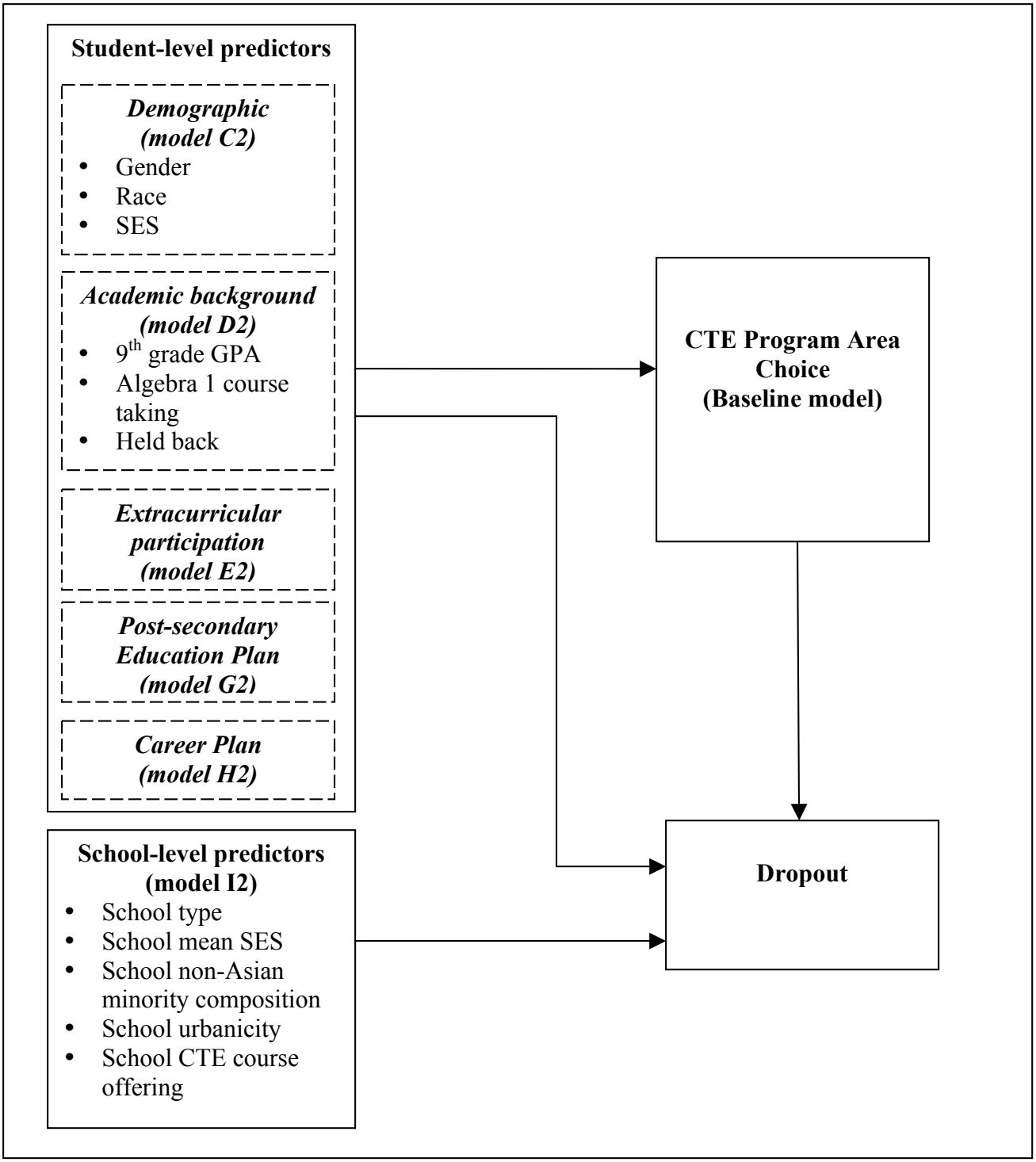

Figure 4.4. **Occupational Concentrators' Dropout Likelihood: Conceptual Diagram**

Table 4.54

Research Question 3: Model Comparison Summary (Unit Specific)

Parameters	**Model A2** (unconditional)	**Model B2** (baseline)	**Model C2** (+demographic)	**Model D2** (+academic)	**Model E2** (+sig. acad.)	**Model F2** (+extracurr.)	**Model G2** (Final)	**Model H2** (+career)	**Model I2** (+L2)
Fixed Effects – Level 1 predictors									
Intercept	-3.125***	-2.766***	-2.925***	-2.868***	-3.287***	-2.722***	-3.285***	-3.223***	-3.134***
	(0.195)	(0.256)	(0.282)	(0.444)	(0.304)	(0.316)	(0.384)	(0.431)	(0.428)
Agriculture		-0.335	-0.2640	-0.126	-0.109	-0.026	-0.132	-0.112	-0.197
		(0.419)	(0.423)	(0.429)	(0.427)	(0.429)	(0.430)	(0.432)	(0.440)
Business		-0.553	-0.545	-0.249	-0.290	-0.266	-0.222	-0.192	-0.180
		(0.329)	(0.353)	(0.364)	(0.363)	(0.366)	(0.368)	(0.370)	(0.369)
2 or more areas		0.092	0.297	0.382	0.387	0.377	0.352	0.369	0.390
		(0.383)	(0.410)	(0.423)	(0.421)	(0.422)	(0.431)	(0.435)	(0.434)
Human Svc		0.486	0.662	0.965*	0.935*	1.026*	1.009*	1.022*	0.998*
		(0.368)	(0.444)	(0.259)	(0.458)	(0.457)	(0.465)	(0.474)	(0.468)
Career		-0.199	-0.199	-0.249	-0.168	-0.242	-0.218	-0.205	-0.285
		(0.415)	(0.421)	(0.536)	(0.430)	(0.429)	(0.430)	(0.431)	(0.440)
Technology Ed		-1.559**	-1.340*	-1.093*	-1.101*	-1.088*	-1.059	-1.052	-1.059
		(0.528)	(0.533)	(0.539)	(0.538)	(0.541)	(0.542)	(0.545)	(0.540)
Gender - Female			-0.448	-0.461	-0.475	-0.472	-0.344	-0.303	-0.349
			(0.311)	(0.325)	(0.321)	(0.322)	(0.335)	(0.343)	(0.336)
Race – Black			0.835**	0.476	0.478	0.615	0.727*	0.798*	0.973*
			(0.312)	(0.328)	(0.322)	(0.329)	(0.330)	(0.337)	(0.429)
Race – Hispanic			0.217	0.063	0.036	0.133	0.167	0.225	0.409
			(0.371)	(0.382)	(0.380)	(0.379)	(0.383)	(0.389)	(0.471)
Race – Others			0.331	0.350	0.324	0.394	0.406	0.419	0.546
			(0.510)	(0.520)	(0.521)	(0.522)	(0.525)	(0.527)	(0.565)
SES, continuous			-0.553*	-0.444	-0.476*	-0.389	-0.300	-0.272	-0.356
			(0.226)	(0.236)	(0.235)	(0.235)	(0.239)	(0.243)	(0.291)
9th grade GPA				-1.125***	-1.164***	-1.052***	-0.950***	-0.953***	-0.946***
				(0.205)	(0.203)	(0.204)	(0.207)	(0.2098)	(0.208)
Took Algebra 1				-0.519					
				(0.378)					

Table 4.54 continued

Parameters	Model A2 (unconditional)	Model B2 (baseline)	Model C2 (+demographic)	Model D2 (+academic)	Model E2 (+sig. acad.)	Model F2 (+extracurr.)	Model G2 (Final)	Model H2 (+career)	Model I2 (+L2)
Held back at least once				0.294					
				(0.315)					
Held back non-respondent				-0.062					
				(0.332)					
School-sponsored act. participation						-1.005***	-0.813**	-0.787**	-0.776**
						(0.257)	(0.265)	(0.267)	(0.267)
No education plan							0.890*	0.818*	0.888*
							(0.345)	(0.355)	(0.348)
Plans to graduate HS or obtain GED							1.087**	1.030**	1.091**
							(0.354)	(0.361)	(0.354)
Plans to enroll in 2-year college							0.477	0.335	0.428
							(0.383)	(0.395)	(0.383)
Career plan non-respondent								-0.436	
								(0.442)	
Career plan: blue-collar								0.305	
								(0.345)	
Career plan: White collar								-0.280	
								(0.352)	
Career plan: Military								-0.378	
								(0.693)	
Career plan: Unclassified								0.364	
								(1.504)	
Fixed Effects: Level 2									
Table 4.54 continued									-1.138
									(1.080)
School mean SES									0.121
									(0.493)
Non-Asian minority %									-0.351
									(0.564)

Parameters	**Model A2** (unconditional)	**Model B2** (baseline)	**Model C2** (+demographic)	**Model D2** (+academic)	**Model E2** (+sig. acad.)	**Model F2** (+extracurr.)	**Model G2** (Final)	**Model H2** (+career)	**Model I2** (+L2)
CTE offer: Non-respondent									0.063
									(0.464)
School offers CTE									0.164
									(0.581)
Urban school									-0.505
									(0.384)
Rural school									-0.316
									(0.314)
Variance Components									
Level-2 intercept	0.509	0.381	0.309	0.286	0.294	0.193	0.167	0.176	0.094
	(0.321)	(0.295)	(0.285)	(0.281)	(0.280)	(0.262)	(0.257)	(0.263)	(0.247)
Goodness-of-fit									
Pseudo R^2		0.251	0.393	0.438	0.422	0.621	0.672	0.654	0.815
#parameters	2	8	13	17	14	15	18	23	25
Deviance	3276.070	3256.030	3239.249	3199.701	3202.330	3186.798	3175.197	3171.462	3169.498
AIC	3280.070	3272.030	3265.249	3233.701	3230.330	3216.798	3211.197	3217.462	3219.498
BIC	3290.636	3314.292	3333.925	3323.508	3304.289	3296.039	3306.287	3338.966	3351.567
Deviance test									
Models compared		A2 vs. B2	B2 vs. C2	C2 vs. D2	D2 vs. E2	E2 vs. F2	F2 vs. G2	G2 vs. H2	G2 vs. I2
χ^2		20.03948**	16.782**	39.548***	2.628	15.532***	11.601**	3.734	5.699

Note 1. ***(p<0.001); **(p<0.01); *(p<0.05)
Note 2. HGLM was performed via Full Maximum Likelihood with Adaptive Gaussian Quadrature
Note 3. Sample size (n) was 1,455 for BIC calculation.

Unconditional Model (Model A2). The unconditional model was built to investigate the predicted average log-odds of dropout likelihood of the 2002 sophomore cohort occupational concentrators. The unconditional model was specified as follows:

Level-1 model: $\eta_{ij} = \beta_{0j}$

where η_{ij} : log-odds (i.e. logit) that occupational concentrator*i* in school *j* drops out of high school,

β_{0j}: mean dropout likelihood in logit scale for school *j*.

Level-2 model: $\beta_{0j} = \gamma_{00} + u_{0j};\ u_{0j} \sim N(0, \tau_{00})$

where γ_{00} : overall average log-odds of dropout episode for occupational concentrators across schools,

u_{0j}: the unique effect of school *j* and it is assumed to be normally distributed as mean is 0 and variance is τ_{00}.

The unit-specific model results obtained revealed an expected dropout log-odds of -3.125 that translates to an expected probability of 0.042. In other words, the finding suggests that a typical occupational concentrator has a 4.2% chance of dropping out of high school. The population average model resulted in an expected dropout log-odds of -2.810, or a probability of 0.057. This finding translates to an average dropout rate of 5.7% across schools, and this estimate is close to a descriptive estimate of 5.4% dropout rate when Asian participants were excluded from the analysis. Summary of the unconditional model results can be found in Table 4.55.

As mentioned earlier, findings from the variance component of the unconditional unit-specific model reflect insignificant variability in log-odds of dropout likelihood among high schools ($\tau_{00} = 0.509$, $p>0.05$). This indicates that the probability of dropping out across high

schools for occupational concentrators is generally the same, which was 0.057 from the population-average model.

Table 4.55

Model A2: Unconditional Model Unit-Specific and Population Average Results

Variable	Unit specific model			Population Average Model		
	Coefficient	Odds Ratio	95% C.I.	Coefficient	Odds Ratio	95% C.I.
Intercept	-3.125***	0.044	0.030, 0.064	-2.810***	0.060	0.046, 0.079

Note. ***p<0.001

Baseline Model (Model B2). The main predictor for research question 3 is CTE program area. The baseline model included 6 dummy variables, representing 6 CTE program areas that were compared with the Trade and Industrial Area, which was designated as the reference group. The baseline model was specified as follows:

Level-1 model: $\eta_{ij} = \beta_{0j} + \beta_{1j}*(D2ORMORE_{ij}) + \beta_{2j}*(DAGRICULTURE_{ij})+ \beta_{3j}*(DHUMAN_{ij}) + \beta_{4j}*(DBUSINESS_{ij})+ \beta_{5j}*(DTECHED_{ij})+ \beta_{6j}*(DCAREER_{ij})$

where η_{ij} : log-odds (i.e. logit) that Trade and Industrial area participant*i* in school j drops out ofhigh school,

β_{0j} :mean dropout likelihood in logit for Trade and Industrial area participants in school *j*,

β_{1j} :mean dropout likelihood in logit for participants in two or more CTE program areas compared to Trade and Industrial area participants in school *j*,

β_{2j} :mean dropout likelihood in logit for Agriculture area participants compared to Trade and Industrial area participants in school *j*,

β_{3j} :mean dropout likelihood in logit for Human Services area participants

compared to Trade and Industrial area participants in school j,

β_{4j}: mean dropout likelihood in logit for Business area participants compared to Trade and Industrial area participants in school j,

β_{5j}: mean dropout likelihood in logit for Technology Education area participants compared to Trade and Industrial area participants in school j, and

β_{6j}: mean dropout likelihood in logit for Career area participants compared to Trade and Industrial area participants in school j.

Level-2 model:

$$\beta_{0j} = \gamma_{00} + u_{0j};\ u_{0j} \sim N(0,\ \tau_{00})$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

$$\beta_{6j} = \gamma_{60}$$

where γ_{00} : average dropout likelihood in logit for Trade and Industrial area participants across schools,

γ_{10} : average difference in dropout likelihood in logit for 2 or more CTE program area participants as compared to Trade and Industrial area participants across schools,

γ_{20} : average difference in dropout likelihood in logit for Agriculture area participants as compared to Trade and Industrial area participants across schools,

γ_{30} : average difference in dropout likelihood in logit for Human Services area participants as compared to Trade and Industrial area participants across schools,

γ_{40} : average difference in dropout likelihood in logit for Business area participants as compared to Trade and Industrial area participants across schools.

γ_{50} : average difference in dropout likelihood in logit for Technology Education area participants as compared to Trade and Industrial area participants across schools.

γ_{60} : average difference in dropout likelihood in logit for Career area participants as compared to Trade and Industrial area participants across schools, and

u_{0j}: unique effect of school *j* after controlling for participant CTE program area membership and it is assumed to be normally distributed as mean is 0 and variance is τ_{00}.

Note that since the random effects associated with β_{1j},β_{2j},β_{3j}, β_{4j}, β_{5j}, and β_{6j},namely u_{1j}, u_{2j},u_{3j}, u_{4j},u_{5j}, and u_{6j},were found to be not statistically significant via full maximum likelihood estimation, they were dropped from the model and therefore β_{1j}, β_{2j}, β_{3j}, β_{4j}, β_{5j}, and β_{6j}were fixed. The AGQ analysis for the model with random terms failed to run.

From the Pseudo R^2 value of 0.251 obtained, 25.1% of level-2 intercept variance, which is the between school variance of dropout rate, was explained by adding CTE program area dummy variables to the model. The unit-specific model results obtained suggested Trade and Industrial participants had dropout average log-odds of -2.766 or a probability of 0.063 dropping

out of high school. It was also found that Technology Education area participants were significantly less likely to drop out than Trade and Industrial participants where Technology Education area participants' coefficient, γ_{50}=-1.599, t_{obs}=-2.951, p<0.01. Other CTE program areas did not appear significant in their dropout likelihood comparison with Trade and Industrial participants. The unit-specific and population-average models coefficients and odds-ratio can be found in Table 4.56. Findings from the variance component of baseline unit-specific model reflect insignificant variability in log-odds of dropout likelihood among high schools.

Table 4.56

Model B2: Baseline Model Unit-Specific and Population Average Results

Variable	Unit specific model			Population Average Model		
	Coefficient	Odds Ratio	95% C.I.	Coefficient	Odds Ratio	95% C.I.
Intercept	-2.766***	0.063	0.038, 0.104	-2.513***	0.081	0.051,0.128
Agriculture area	-0.335	0.715	0.315, 1.626	-0.249	0.780	0.316,1.924
Business area	-0.553	0.575	0.302, 1.096	-0.436	0.647	0.317,1.319
2 or more areas	0.092	1.096	0.518, 2.323	0.178	1.195	0.515,2.773
Human svc area	0.486	1.626	0.790, 3.344	0.244	1.276	0.567,2.876
Career area	-0.199	0.820	0.363, 1.849	-0.442	0.643	0.253,1.632
Tech Ed area	-1.559**	0.210	0.075, 0.592	-1.370*	0.254	0.084,0.767

Note. ***p<0.001, **p<0.01, *p<0.05.

Final model (Model G2). After running the HGLM analysis including level-1 predictors and level-2 predictors, Model G2 was decided as the final model as it was found to be the most parsimonious in explaining CTE program areas and likelihood of dropping out of high school. It was found that Algebra 1 course taking, being held back a grade, career plan, and all of the

school level predictors were found to be statistically insignificant, and therefore were dropped from the model.

All categorical and dummy variables in this model were uncentered while continuous variables F1SES2 (student SES) and F1RGP9 (student 9th grade GPA) were grand mean centered. The reference group for this model has the following characteristics:

1. in the Trade and Industrial program area
2. males
3. Whites
4. average SES (mean)
5. average GPA (mean)
6. did not participate in school-sponsored activities
7. planned to enroll in 4-year college

The unit-specific model results from the HGLM analysis via AGQ revealed that the reference group's coefficient of dropping out of high school is -3.285, which translates to a 0.036 probability of dropping out for a White male participant who was in the Trade and Industrial program area, with average SES and 9th grade GPA, did not participate in school-sponsored activities, and planned to enroll in a 4-year college. To investigate the differences between various CTE program areas in their dropout likelihood, a multiple comparison analysis with Bonferroni correction was performed, and is presented in Table 4.57. From the results obtained, students in the Human Services area were significantly more likely to drop out than all other areas accept students who were concentrators in 2 or more CTE program areas. Students in the Technology Education area were significantly less likely to drop out than students in the Human

Services area and concentrators of more than 2 CTE program areas. All other comparisons were found to be statistically insignificant.

Table 4.57
Multiple Comparison Analysis for CTE Program Areas (in logit scale)

		Agriculture	Business	Career	Human Services	Tech Ed	Trade
Reference group	Business	-0.090					
	Career	-0.086	-0.004				
	Human Services	1.141*	1.231**	1.227*			
	Tech Ed	-0.927	-0.836	-0.841	-2.068**		
	Trade	0.132	0.222	0.218	-1.009*	1.059	
	2 or more	0.484	0.575	0.570	-0.657	1.411*	0.352

Note. **p<0.01, *p<0.05.

For demographic predictors, only one race dummy variable showed significance in predicting dropout likelihood among occupational concentrators in the model. African American participants were significantly more likely to drop out than White participants, while other race groups did not differ significantly from the Whites in their likelihood to drop out of high school. As mentioned previously, Asians were excluded in the analysis due to their 0% dropout rate. Interestingly, gender was consistently observed as an insignificant predictor of dropout likelihood among occupational concentrators, while SES became an insignificant indicator of dropout among occupational concentrators after school-sponsored activities participation and education plans were included in the analysis.Nevertheless, all demographic variables were maintained in the model to control for individual background differences.

The only academic background variable included in the model was 9th grade GPA. From the results obtained, a coefficient of γ_{12} = -0.950 translates to an expected odds of dropping out of 0.387. Alternatively, for every 1 standard deviation unit (0.713) increase in 9th grade overall GPA, the relative odds of dropping out for an occupational concentrator is 0.276, *ceteris paribus*. Figure 4.5 illustrates this relationship. Other academic background variables, namely Algebra 1 course-taking and being held back a grade in school, did not have any significant influence on dropout likelihood.

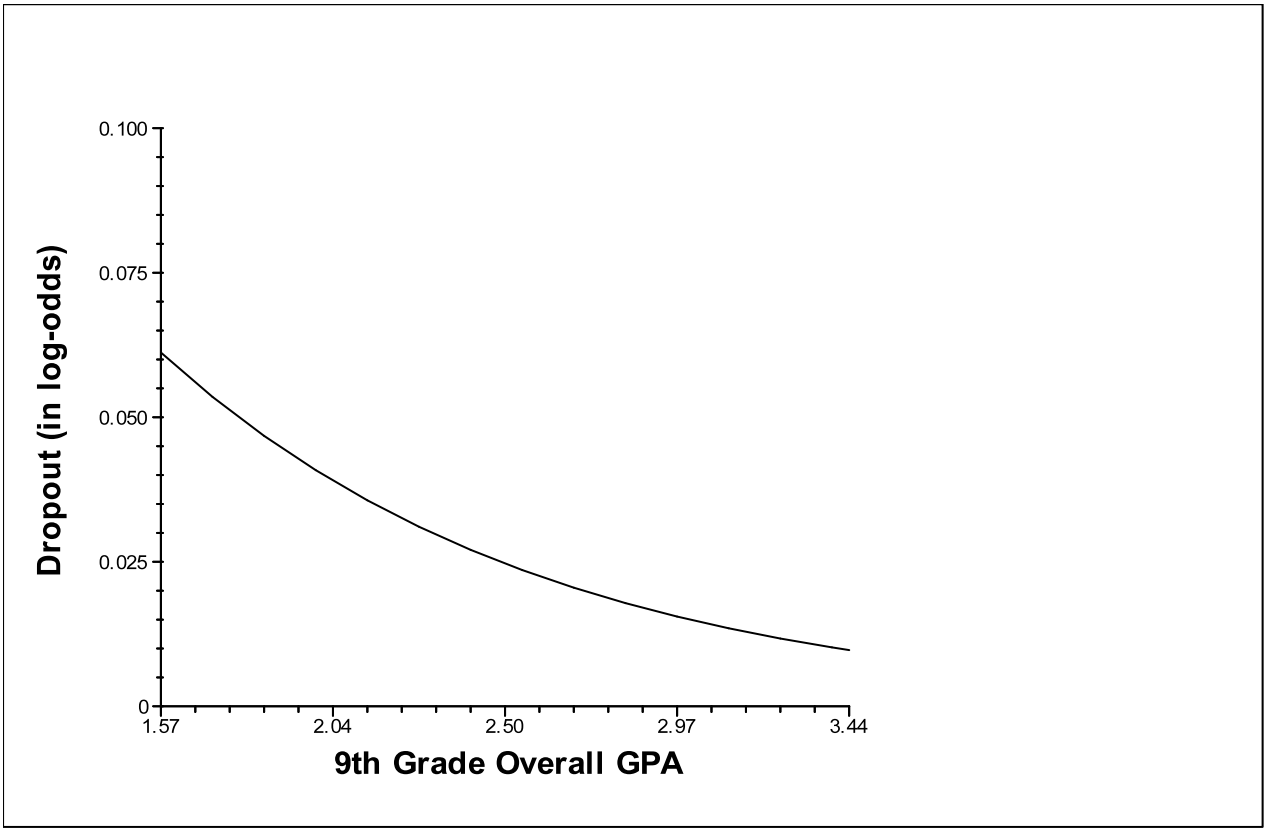

Figure 4.5. **9th Grade Overall GPA and Dropout Likelihood for Occupational Concentrators, Ceteris Paribus**

School-sponsored activities participation consistently shows significance in predicting dropout likelihood among occupational concentrators. In the final model, the coefficient obtained was [γ_{13}=-0.813, t_{obs} =3.069, p<0.01], suggesting that by participating in school-sponsored activity, the chances of dropping out of high school among occupational concentrators decreases.

Post-secondary education plans appears to be an important predictor of dropout likelihood among occupational concentrators. Participants who indicated that they do not have any plans for post-secondary education or indicated that they plan to only graduate high school or obtain GED were significantly more likely to drop out of school. Those who indicated 2-year college as their post-secondary education plan did not differ significantly from the reference group who stated 4-year college or postgraduate studies as their plan.

In short, only level-1 or student-level predictors were crucial in predicting dropout likelihood among occupational concentrators. The different CTE program areas did show significant differences in dropout likelihood, where Human Services area participants were more likely to drop out than other groups, and Technology Education area participants were less likely to drop out than Human Services area participants and participants who were concentrators in 2 or more CTE program areas. The detailed results of Model G2 unit-specific and population-average models are presented in Table 4.58.

Although Technology Education area participants did not show statistical significance differences with Trade and Industrial education participants in the model, its odds ratio value of 0.347 reflects substantial differences with Trade and Industrial area participants where Technology Education area participants were substantively less likely to drop out. Most likely issues with sample size might have influenced this result. A bigger sample size could trigger

statistical significance between Trade and Industrial and Technology Education area participants in the HGLM model.

Dissecting further on the conditional dropout likelihood in logit (log-odds) scale, Figure 4.6 illustrates where each of the program areas in this study lies in comparison with each other. From the figure, Technology Education participants had the lowest likelihood of dropping out, followed by Business area participants. Human Services area participants had the highest log-odds of dropping out of high school when compared with other occupational concentrators.

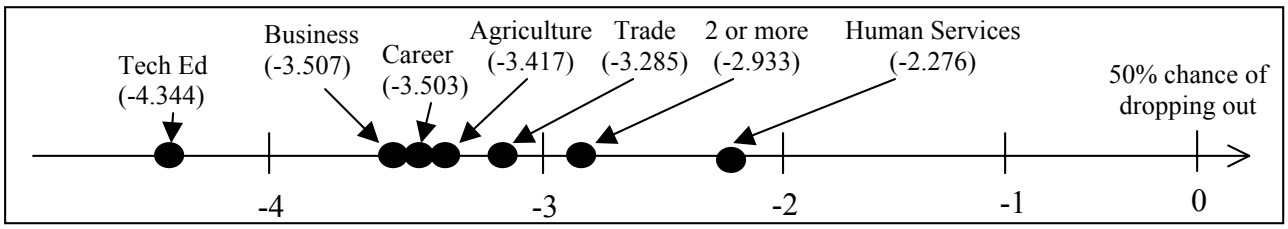

Figure 4.6. **A Map of Conditional Dropout Likelihood in Logit Scale**.

Table 4.58

Model G2: Unit-Specific and Population-Average Models Coefficients and Odds Ratio

	Unit-specific model			Population-average model		
Variable	Log-odds, γ_{q0}	Odds ratio	95% C.I.	Log-odds, γ_{q0}	Odds ratio	95% C.I.
Intercept	-3.285***	0.037	0.018, 0.079	-3.019***	0.049	0.023, 0.106
2 or more areas	0.352	1.422	0.611, 3.309	0.597	1.817	0.702, 4.700
Agriculture area	-0.132	0.876	0.377, 2.036	-0.038	0.963	0.389, 2.381
Human Services area	1.009*	2.743	1.103, 6.824	1.148*	3.152	1.140, 8.717
Business area	-0.222	0.801	0.389, 1.648	0.052	1.053	0.472, 2.353
Technology Education area	-1.059	0.347	0.120, 1.003	-0.991	0.371	0.116, 1.189
Career area	-0.218	0.804	0.346, 1.868	-0.433	0.649	0.248, 1.695
Female	-0.344	0.709	0.368, 1.367	-0.699	0.497	0.239, 1.035
Race: African American	0.727*	2.069	1.084, 3.950	0.575	1.777	0.861, 3.670
Race: Hispanic	0.167	1.182	0.558, 2.503	-0.219	0.803	0.345, 1.870
Race: Others	0.406	1.501	0.536, 4.200	0.739	2.094	0.647, 6.774
SES	-0.300	0.741	0.464, 1.183	-0.128	0.880	0.525, 1.473
9^{th} grade GPA	-0.950***	0.387	0.258, 0.580	-0.824***	0.439	0.279, 0.689
Activities participation	-0.813***	0.444	0.264, 0.746	-0.763*	0.466	0.261, 0.833
Post-sec. plan: None	0.890*	2.435	1.238, 4.788	0.687	1.988	0.924, 4.277
Post-sec. plan: HS/GED	1.087**	2.965	1.482, 5.935	1.395***	4.035	1.864, 8.734
Post-sec. plan: 2-yr college	0.477	1.611	0.761, 3.413	0.584	1.793	0.773, 4.157

Note. *p<0.05, **p<0.01, ***p<0.001

Summary

Detailed descriptive analyses and HGLM models were presented to answer the 3 research questions addressed in this study. Research questions 1 and 2 addressing curriculum track choice and dropout likelihood excluded dual concentrators from the HGLM analysis because no one from the dual track dropped out. Analysis to investigate research question 3, related to CTE program areas, excluded the Asian race group due to the same reason.

From the results obtained, curriculum track choice was found to be a significant predictor of dropout likelihood among the 2002 sophomore cohort after controlling for various student-level and school-level predictors. Student-level predictors that were observed to have statistical significance in predicting dropout likelihood were demographic: (a) race, and (b) SES; academic background: (a) 9th grade overall GPA, (b) Algebra 1 course taking, and (c) being held back a grade in school; school-sponsored activities participation; and post-secondary education plans. Gender effect and participants' career plans for age 30 appeared to have no significance in predicting dropout likelihood. The only school-level predictor that had statistical significance was school type, whether participants went to a public or private school. Private school participants were less likely to drop out of school as compared to their public school counterparts.

In addressing occupational concentrators specifically, different CTE program areas showed variability in dropout likelihood, where Human Services area participants were more likely to drop out than their occupational concentrator counterparts. The HGLM model built suggested that race, 9th grade overall GPA, school-sponsored activities participation, and education plans were significant predictors of dropout likelihood among occupational

concentrators. Gender, participants' career plans for age 30 and none of the school-level predictors were significant in the model.

Generally, the findings agree with previous literature on several factors that are associated with dropout likelihood such as race, SES, academic background, and school type. By addressing curriculum track choices and CTE program area as a main predictor, several of these literature-suggested factors' magnitudes of influence on dropout likelihood were either suppressed or inflated. Implications of these results are discussed in Chapter 5.

CHAPTER 5

CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

Dropping out of high school is never a desired outcome for students, parents, the society, and the nation. Due to the multitude of negative consequences associated with high school dropouts, they are often perceived as detrimental to the well being of the society and economic progression. Nonetheless, numerous researchers agree that dropping out of high school is not an overnight decision, but it is a longitudinal process, built upon a series of failure and frustration that occur throughout one's schooling career. The major purpose of this study was to address the impact of the most substantial part of a student's schooling career, curriculum track choices, on dropout likelihood. The 3 research questions addressed were:

10. To what extent do high school students of various curriculum tracks differ in the likelihood of dropping out of high school, after controlling for major possible individual differences?

11. How do institutional factors related to curriculum track (such as minority composition, level of neighborhood poverty, available funding, and CTE courses offered) associate with the likelihood of students dropping out of high school?

12. How do different career and technical education areas differ in the likelihood of dropping out of high school?

This study utilized the Education Longitudinal Study of 2002 (ELS) dataset, available from the National Center for Education Statistics (NCES) and employed the hierarchical generalized linear modeling (HGLM) methodology to build models that explain the significance of curriculum track choices and other predictors in their relation with dropping out of high school. All analyses were conducted using normalized weights derived from the second follow-up

transcript weight that was available from the ELS dataset. Dual concentrators were excluded from the HGLM analysis in addressing research questions 1 and 2 while Asian race group was excluded from the HGLM analysis addressing research question 3 due to the non-occurrence of dropouts among these groups.

Conclusions

The findings from this study confirm the notion that different curriculum tracks yield different likelihoods of dropping out among high school students, after taking into consideration individual and institutional (i.e., school) differences that were possible to determine from the dataset. The summary of major findings is as follows:

1. It can be concluded that academic and occupational concentrators were substantially less likely to drop out than their general curriculum counterparts. The HGLM model indicated only explained 40.4% of dropout likelihood variance could be explained by curriculum track choice, academic background, post-secondary education plans, school-sponsored activity (extracurricular and co-curricular activities) participation, demographic, and school type.
2. Dual track participants were incomparable to the other 3 groups studied as HGLM analysis could not produce a logit statistic to predict dropout likelihood for dual concentrators due to non-occurrence in the dataset. Nevertheless, non-occurrence of dropouts from dual track is an important finding itself that concurs with previous research on the effectiveness of dual enrollment programs.
3. Only school type was a significant school-level variable in predicting dropout likelihood among the 2002 high school sophomore cohort, where public school students were more likely to drop out than private school students. All other school-level predictors appeared to be insignificant predictors in the HGLM model.

4. For occupational concentrators, it was found that the Family and Consumer Sciences, Human Services, Public Services, Health, & Education area (Human Services area) participants were significantly more likely to drop out of school compared to other occupational concentrators, except for students who were in 2 or more CTE program areas. Technology Education participants were significantly less likely to drop out than Human Services area and 2 or more CTE program area participants. Though not statistically significant at .05 level, Technology Education area participants were substantively less likely to drop out than Trade and Industrial area participants after all possible individual differences were controlled for. Insignificant variance across schools was observed, and no school-level predictors were found to have any statistically significant impact in predicting dropout likelihood among occupational concentrators.

Discussion

There is no one absolute factor that carries the most weight in determining high school success. Likewise, dropping out of high school is not influenced by only one factor, but it is a longitudinal decision-making process that builds upon an array of factors revolving around high school students. This study suggests that what academic path students take in school has demonstrated importance in this process, and as suggested by Plank, DeLuca, and Estacion (2008), the sequence of courses that students take in high school greatly defines their schooling experiences. Tinto's (1975) model articulates that student integration with the academic segment of high school, alongside the social aspects, defines how students identify with their schooling careers and thus impacts success. This is also in accordance with Finn's (1989) participation-identification theory in which the study results brought about the bonding element that needs to exist between students and their school in order to achieve desired outcomes.

Curriculum Track Choice and Dropout Likelihood

Overall, a dropout rate of 9.2% was observed for the sophomore cohort of 2002. This number includes those dropouts who were pursuing or had completed the General Education Development (GED) during the study period. In other words, approximately 1 out of 10 students who were high school sophomores in 2002 dropped out of high school. This number, however, does not represent the absolute dropout rate for the class of 2005, which varies in several reports, based on the definitions of dropout rates used in the studies. For example, national status dropout rate of 2005 of 8.7% was reported by Cataldi, Laird, KewalRamani, and Chapman (2009) and 9.4% was reported by Laird, Lew, DeBell, and Chapman (2006).

Academic and occupational concentrators were significantly different from general track participants in the likelihood of dropping out, where academic concentrators had about 96.5% lower odds in dropping out than general track participants when all significant predictors were controlled for. In other words, two students of the same gender, race, socioeconomic status (SES), 9th grade GPA, Algebra 1 course-taking, grade retention, and extracurricular participation history, post-secondary education plans, and went to the same type of school, would differ significantly in odds of dropping out (about 1 to 28.6) with the student who followed academic track is substantially less likely to drop out than the student who completed general curriculum requirements. The odds of dropping out are also substantially lower for occupational concentrators, or about 1 to 3.8 odds of dropping out, as compared to general track participants after all possible differences are accounted for. These findings are synonymous with those of Rumberger and Sun (2008), Plank (2001), and Plank, DeLuca, and Estacion (2005) where their research related to course-taking and dropout rates indicated lower dropout risk among academic and occupational concentrators. While there were arguments that occupational or career and

technical education (CTE) concentrators take less rigorous academic classes (Oakes, 2005), the findings from this study revealed that after all academic background variables were controlled for, general track participants showed substantially higher odds of dropping out than occupational concentrators.

Student-level predictors. Interestingly, gender effect became insignificant in predicting dropout likelihood after post-secondary education plans were included in the model. Further descriptive investigation revealed that female participants were more likely to indicate 4-year college or postgraduate studies as their post-secondary destinations, and also they were more inclined to be in an academic track as compared to male participants. Analyzing the relationship between track choices and post-secondary education plans, a majority of academic concentrators indicated 4-year college or postgraduate studies as their post-secondary education plans, and this statistic coincides with the findings of Oakes (2005) and Akos (2007) that post-secondary education choices were driven by the curriculum track that the students choose. The relationship between track choices and post-secondary education plans was statistically significant at $p<0.05$, and therefore it can be concluded that when participants were in the academic track, they were more likely to have higher post-secondary aspirations, regardless of gender. As such, the likelihood of dropping out would be the same for a male or a female high school student if they were in the same track and had similar post-secondary education plans.

Another observation that was apparent was the consistent substantive influence that 9th grade overall GPA had in predicting dropout likelihood among the 2002 high school sophomore cohort. The odds of dropping out for students with higher GPA are reduced significantly, and alongside with statistical significance reflected by the other two academic background proxies, having been held back and Algebra 1 course-taking, academic background established its ground

in defining high school success. These outcomes are in accordance with previous studies that repeatedly iterate academic risk factors as detrimental to students' achievement in school (Allensworth, 2009; Fine & Davis, 2003; Goldschmidt & Wang, 1999; Jimerson, 2001; Lee & Burkam, 2000; Plank, 2001; Rumberger & Sun, 2008; Silver, Saunders, & Zarate, 2008; Stearns et al., 2007). Results also confirm students' positive academic integration relationship with the likelihood of retention as suggested by Tinto's (1975) model.

From another perspective, the effect of GPA on dropout likelihood relates to a decrease in the SES main effect magnitude. Prior to the inclusion of academic background in the HGLM model, the odds ratio for SES was 0.462, which means that comparing two students who differ by one standard deviation in SES, the student with higher SES has lower odds of dropping out than the student with lower SES. However, after academic background variables were included, the odds ratio for SES was found to be 1.584. This finding is interesting, as there seems to be a superior effect on dropouts related to academic background over SES. Once academic background is controlled for, SES effect became a much less important predictor.

Previous studies by Knifsend and Graham (2005) as well as Stearns and Glennie (2010) suggested associations between participation in extracurricular activities and positive academic outcomes as well as the decision to stay in school, although the magnitudes of influence might differ, as found by Fredricks and Eccles (2010). In this study, the dichotomy of participation was used and those who participated at least an hour per week in school-sponsored extracurricular activities were found to have substantially lower odds of dropping out than those who did not participate at all. As this variable was used as a proxy for integration with the school's social system in Tinto's (1975) model, the results confirm that student positive engagement with the high school's social system reduces the chances of dropping out.

Exploring the relationship between high school sophomores' future career plans and dropout likelihood, this variable did not portray any significance that might influence the decision to stay in school. At 10th grade, career plans might be too distant a future for students to relate to their schooling achievements, as opposed to post-secondary education.

School-level predictors. This study has shown school type (i.e., public or private school) as the only school-level predictor that was significant in predicting dropout likelihood, after controlling for curriculum track choice and other student-level predictors (demographic factors, academic background, post-secondary education plans, and school-sponsored activity participation. This finding agrees with Evans and Schwab (1995), Rumberger and Palardy (2005), and Rumberger and Thomas (2000), who indicated that private schools produced lower dropout rates than public schools. However, in contrast to previous research by Balfanz (2009), it was found in this study that school mean SES, which was a proxy for school poverty level and also available resources, was non-significant. Two other school-level predictors, minority composition and school urbanicity, were also non-significant predictors of dropout likelihood. Descriptively, these school-level predictors showed statistically significant differences between dropouts and non-dropouts, but their effects were suppressed after curriculum track and the student-level predictors were placed at center stage in the HGLM model.

CTE Program Areas and Dropout Likelihood

Results that addressed the third research question in this study showed no substantive differences between different concentrators in CTE program areas in the likelihood of dropping out. Even though the Family and Consumer Sciences, Human Services, Public Services, Health, and Education area (human services area) concentrators tended to have higher chances of dropping out than Trade other area concentrators, the odds ratio outcome suggested that this

finding is not substantive. It was also found that there was no statistically significant variation of dropout likelihood among schools for occupational concentrators. The student-level predictors that were of importance in determining the chances of an occupational concentrator to drop out were 9th grade overall GPA and school-sponsored extracurricular activities participation. Gender, race, and SES did not have any significant effect on dropout likelihood among occupational concentrators. School-level predictors did not show any significance in influencing dropout likelihood among occupational concentrators.

The results obtained from the statistical analysis performed to investigate dropout likelihood differences between various CTE program areas supported the finding that academic achievement and participation in extracurricular activities were associated with ensuring occupational concentrators graduate from high school. These findings were in contrast with Ainsworth and Rocigno (2005), who found that participation in the Trade and Industrial program area produced significantly higher likelihood of dropping out as compared to other CTE areas, while participation in other program areas were non-significant in determining dropout likelihood.

Occupational and General Track Comparison

As mentioned at the beginning of this chapter, occupational concentrators had lower odds of dropping out of school than general track participants. Interestingly, results from this study uncovered similarities in several characteristics between occupational concentrators and general track participants. Comparing the 9th grade overall GPA between general and occupational track, participants from both curriculum choices had the same mean GPA of 2.50. There were 9.1% of the occupational concentrators and 8.2% of the general track participants who did not take Algebra 1. In terms of grade retention, occupational concentrators and general track participants

had 13.8% and 11.8% held back rate respectively. Additionally, 67.6% of the occupational concentrators and 70.9% of the general track participants participated in school-sponsored extracurricular activities.

One aspect on which the two groups differed was educational aspirations. When post-secondary plans were analyzed, 15.1% of the occupational concentrators indicated 2-year college as their destination, while only 6.8% of the general track participants indicated likewise. However, a higher percentage of general track participants (73.3%) indicated 4-year college or postgraduate studies as their destination, compared to occupational concentrators who had a lower percentage (62.3%). In terms of career plans, differences were observed, but this variable was insignificant in predicting dropout likelihood. Most likely, occupational concentrators perceive 2-year institutions such as community colleges to be more relevant to continue what they are learning in school.

The apparent higher tendency observed among occupational concentrators to graduate from high school as compared to students who follow the general curriculum concurred with CTE proponents who argue that an occupational or CTE track helps to reduce dropout tendencies (Plank, 2001; Plank, DeLuca, & Estacion, 2005; Rumberger, 2011). Historically, CTE or vocational education was regarded as a track for at-risk students who were presumed to not pursue their education at the post-secondary level, in that CTE would provide them with necessary skills for employment after high school (Castellano, Springfield, & Stone, 2001; Castellano, Sundell, & Overman, 2010). From the results of this study, it can be implied that when student academic background and post-secondary aspirations were controlled for, occupational concentrators were more "dropout proof" than students who were not following any specific curriculum track. Plank, DeLuca, and Estacion (2005) claimed that CTE appears more

relevant and provides the skills needed by students to utilize in their careers or post-secondary education, and this helps students decide to stay in school. Taking a sequence of courses in a field that the students are interested in, such as culinary arts, auto mechanics, or early childhood education, helps them integrate and connect with their academic aspect of school and thus reduces the chances for dropping out. This integration is an essential component outlined by Tinto (1975) to increase retention, and is especially important for students who possess risk factors such as low GPA or have had grade retention history.

In short, two students who possess the same characteristics studied in this research differ in the likelihood of dropping out when one student follows an occupational track and the other goes through a general curriculum. When risk factors were identified, it is more likely for students who were placed or chose to be in an occupational track to graduate from high school, rather than those placed in courses that will only satisfy minimum graduation requirements.

Dual Track – No Dropout Occurrence

Dual track concentrators yielded a 0% dropout rate, which was a substantial finding that agrees with the effectiveness of academic and career technical education (CTE) integration as promoted by several researchers who found that this integration is associated with improved academic outcomes, improved retention rates, and enhanced student motivation (Pearson et al., 2010; Plank, 2001; Plank, DeLuca, & Estacion, 2005; Stone et al., 2006; Young et al., 2011). Dual track programs such as career academies and High Schools That Work (HSTW) have been consistently reported to have positive effects on student outcome, where HSTW was one of the most effective dropout prevention programs identified by the What Works Clearinghouse. Although the nature of dual track programs that ELS participants followed in their schools (e.g., HSTW, career academy, tech prep) cannot be determined from the dataset, the requirements that

were outlined for a participant to be considered a dual concentrator reflect rigor that has been argued to be lacking in American public high schools. It has been mentioned in the literature that career academies, for instance, exemplify this rigor as this program has "aimed to blend academic rigor, a curriculum spanning college-readiness and workplace knowledge, and engaging and relevant experience in the workplace" for more than 35 years (Smith, 2008, p. 1).

From descriptive analysis conducted on the characteristics of dual track participants, it was found that there were similarities with academic concentrators, especially in their academic backgrounds and post-secondary education plans. The only difference was in terms of school type, in that 98% of dual concentrators and 83.8% of academic concentrators attended public schools. Private schools such as Catholic schools tend to concentrate on college preparation programs (Lee & Ready, 2009). On the other hand, dual programs that integrate academic and career and technical education (CTE) happen mostly in public schools, in collaboration with community colleges (Hoffman, Vargas, & Santos, 2009). These results suggest that academic and dual concentrators possess similar characteristics and also yield similar dropout likelihood when compared with general track participants.

Recommendations for Practice

The term "tracking" has also been negatively assumed to be an undesirable practice in education. However, tracking can take an improved definition as suggested by this study. Tracking does not necessarily mean ability grouping, but rather an effort to cater to a variety of needs that exist in a diverse society that will help each individual student achieve positive schooling outcomes. Tracking through offering a wide variety of courses ranging from hands-on culinary arts courses right up to the study of college-level physics will offer students an

abundance of choices that will suit their individual interests, needs, and capacities to obtain the most sought-after high school diploma.

Since this study associates better high school outcomes with placing students in an occupational, dual, or academic track, as opposed to the general curriculum, general track or minimum graduation requirements option should be abolished. Schools should identify additional resources to make specific curriculum options, namely academic, occupational, and dual tracks, available to all students. According to Stone III (2004), "forty-three percent of high school graduates in 1998 were general concentrators, a track known for its less-than-rigorous curriculum and that fails to prepare students with the skill requirements necessary to be successful in either post-secondary education or in the workplace" (para. 7). A "one curriculum for all" notion might not be the best-fitting model in a diverse society like the United States, and therefore efforts must be taken to provide for the varied students' needs. As an example, the "College Preparatory Curriculum for All" implemented in Chicago public schools has been criticized by experts as it has shown negative results for students who were not interested in higher level academic courses and the curriculum actually increased dropout rates (Allensworth et al., 2009; Lee & Ready, 2009). A lot of factors have to be looked into for schools to offer CTE and dual track curriculums. In order to implement this idea, staff development, investment in more technologically advanced infrastructure, and better linkage to post-secondary education and employment opportunities must be present (Castellano, Springfield, & Stone III, 2003).The Carl Perkins II Act of 1990 mandated that for schools to be entitled for funding under this act, integration between CTE and academic curricula must be present, and schools must be accountable for the efficacy of the programs that they offer as well as promote workplace skills in their programs (Dalton & Bozick, 2012; Stone, 2002). Therefore, there are avenues for schools

to implement CTE and dual track programs to meet the needs of students who want to pursue a career-oriented post-secondary destination.

It was also found in this study that academic and dual concentrators possess similar characteristic. It can be recommended that instead of only directing students with strong academic backgrounds toward an academic track curriculum such as a college preparatory program, they do have the choice to take a combination of college prep courses alongside CTE courses. This integration between the two areas introduces relevance to workplace skills, and thus prepares the students for post-secondary education and employment simultaneously.

The occurrence of curriculum tracking most likely precedes entrance to high school. By examining when and how curriculum track choice occurs, schools might be able to better guide students at risk of dropping out through more appropriate course placements that will help suppress dropout likelihood. Figure 5.1 illustrates when curriculum tracking might have started to occur, and when at-risk factors could have been detected based on previous literature. By analyzing this timeline, parents, teachers, and counselors might be able to assist students in channeling them to the right courses at the right time that will help them complete high school successfully. According to Dalton and Bozick (2012), a developmental perspective of high school dropouts spans the decision of dropping out from elementary school right up to the point when dropout actually occurs. Additionally, Plank (2001) concluded in his study that middle school achievement is an important factor that navigates students' high school curriculum choices. When students take courses like Algebra 1, which is a pre-requisite to higher level math in high school, it is almost certain that they will go through an academic track as opposed to the general track. CTE course-taking has also moved away from the presumption that occupational concentrators tend to be kept at lower level courses. Levesque (2003) reported that the number of

courses in higher math CTE students took increased while the number of lower math courses they took decreased.

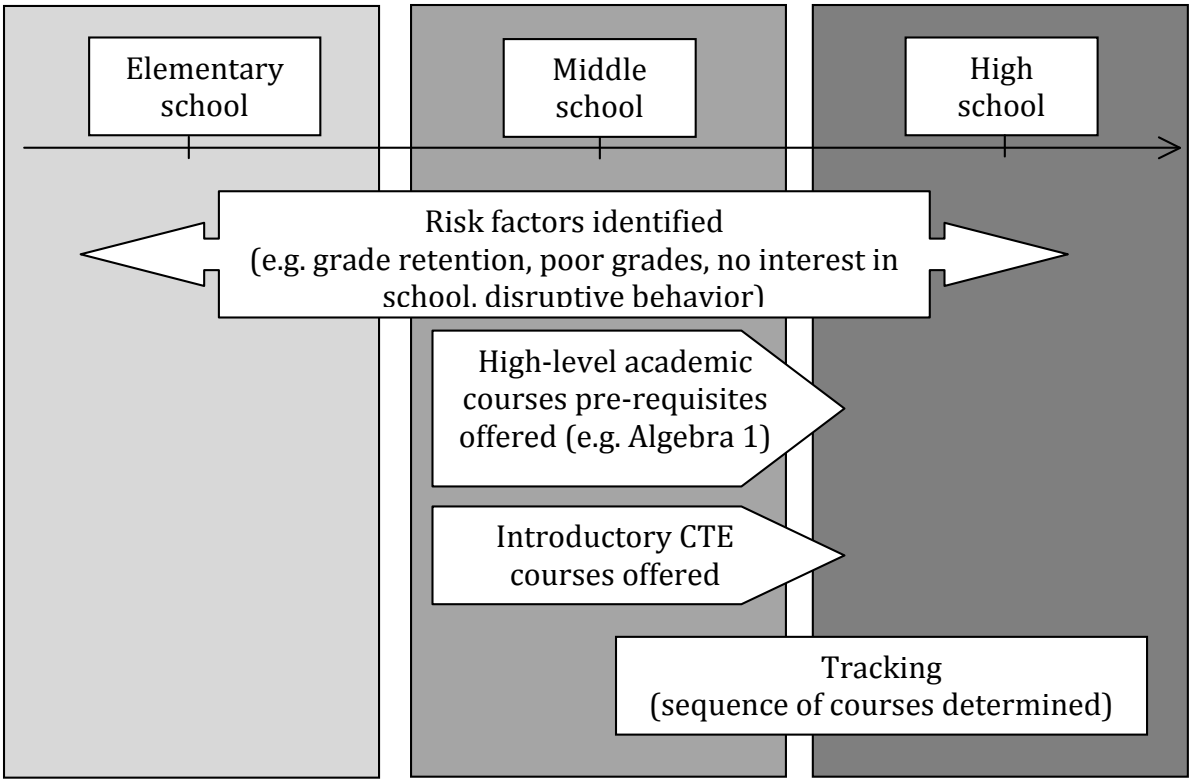

Figure 5.1. **Curriculum Track Choice Timeline**. Identifying risk factors, student needs, and interest will better assist students in making curriculum choices that help them stay in school.

When students who are at risk can be identified at an early stage, and intervention measures are taken to increase the likelihood of retention, the dropout phenomenon can be suppressed. One way is through proper placements in curriculum tracks, as suggested by the results of this study. While not ignoring other factors that were not addressed in this research such as behavioral problems, peer pressure, parental expectations, and economic hardship, if student engagement can be strengthened through taking courses that are of interest to them, students might make better decisions about staying in school.

For occupational concentrators, it was found that having a post-secondary education goal and participating in extracurricular activities substantially reduced the likelihood of dropping out. As such, students should be exposed to post-secondary education choices so that they will be able to strive toward this realistic goal that is achievable in the near future. On the same note, when students know their goals, it is more likely that they will choose the courses that they are interested in and work toward acquiring the skills and knowledge needed so that they will be successful in their higher education or career endeavors. Occupational concentrators also need to be involved with school-sponsored activities to boost their attachment with the school's social aspect, as recommended by Tinto's (1975) model to increase retention.

Recommendations for Policy

1. As there has been continuous propagation of college-ready and career-ready ideas recently, in line with the efforts in improving the No Child Left Behind Act through reauthorization of the Elementary and Secondary Education Act, curriculum path choices must be emphasized. There should be a policy in which students must be able to complete a sequence of courses within their area of interests, and to move away from minimum graduation requirements.
2. Rather than focusing on academic achievement exclusively, student involvement with school-sponsored activities must also be emphasized so that students not only focus on assessments and examinations, but also develop their social skills needed to be career-ready. As such, policies on providing enough avenues for schools to provide a variety of extracurricular and co-curricular activities should be in place so that various student interest and talents can be served.
3. CTE and academic integration appeared to impact high school students' completion positively. As such, state and district authorities should promote the collaboration between

CTE and academic teachers in their teaching practices so that students can better apply the theoretical knowledge obtained from academic classes in more hands-on approach via CTE programs.

4. Each state's Department of Education should provide enough training, information, and facilities to assist counselors and teachers in student course placements based on needs, interests, and abilities.

Recommendations for Further Research

1. The ELS dataset was utilized to address the research questions in this study. Despite its comprehensiveness on high school data, middle school information was not available. One of the predictors repeatedly iterated in the literature to have an impact on dropout likelihood is middle school achievement. Therefore, this study could yield better prediction models through including middle school information.
2. Due to the absence of random assignment in curriculum tracking, causal implications cannot be made. Another advanced methodology in the social sciences that is emerging is the use of propensity score matching. This method allows for better control on pre-existing differences among the participants that will mirror experimental design random assignment and thus, causal implication is possible (Deheija & Wahba, 2002).
3. As comparison with dual track concentrators was not possible, other methodology can be explored to include this group in the study so that a comparative conclusion may be established. Increasing the sample size could possibly include dropouts among dual track concentrators.

4. This study could be duplicated to analyze each state's report card on the curriculum tracks that they offer and the outcomes can be compared, as this study utilized a nationally representative sample.
5. When curriculum track was controlled for at the student level in this study, school-level effects were suppressed, except for school type. Focused analysis on school-level variables might yield different results when comparing programs that each school offers and to see whether their offering of different programs influences dropout likelihood.
6. A path-analysis study to address if curriculum track has a mediating effect instead of a main effect could explore a different view of the problem. Originally, this study intended to view curriculum track as a mediating factor, but due to the nested data nature, HGLM was the method of choice so that school-level variance could be analyzed. By examining curriculum track as a mediating factor, Tinto's (1975) model could be better addressed, and controlling for individual differences via propensity score matching methods could reduce selection bias issues, thus giving a more accurate representation of curriculum track differences in association with dropout likelihood.

Final Thoughts

In a recent report by The New York Times, Levin and Rouse (2012) mentioned that in recent years, only 7 out of 10 ninth graders graduate from high school, which translates to a 70% graduation rate. The dropout phenomenon is a complex problem that is of national interest as it affects the economy and society as a whole. As the world becomes increasingly competitive, education ensures that a nation stays on top of its progression. As Thomas Friedman said in his renowned book, *The World is Flat*, published in 2005:

“When I was growing up, my parents told me, 'Finish your dinner. People in China and India are starving.' I tell my daughters, 'Finish your homework. People in India and China are starving for your job.”

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APPENDIX A

CTE Program Area by State

State & CTE Website	CTE Program Areas
Alabama (http://www.alcareertech.org/)	• Agriscience Education • Business and Marketing Education • Family and Consumer Sciences • Health Science • Technical Education
Alaska (http://awib.alaska.gov/cte_programs.htm)	16 career clusters
Arizona (http://www.azed.gov/career-technical-education/)	16 career clusters
Arkansas (http://ace.arkansas.gov/Pages/default.aspx)	• Agricultural Science & Technology • Apprenticeship and Applied Sciences • Arts, AV Technology and Communications • Business and Marketing Education • Career Guidance, Exploration, and Preparation • Family and Consumer Sciences • Skilled and Technical Sciences • STEM
California (http://www.cde.ca.gov/ci/ct/)	• Agriculture Education • Arts, Media, and Entertainment Education • Business and Marketing Education • Health and Human Services Education • Home Economics Careers and Technology Education • Industrial and Technology Education
Colorado (http://www.coloradostateplan.com/CTE/CTE_2012_FACT_SHEET.pdf)	• Agriculture, Natural Resources & Energy • Business, Marketing, and Public Administration • Hospitality, Human Services, and Education • Health Science, Criminal Justice, and Public Safety • Skilled Trades and Technical Sciences • STEM, Arts, Design, and Information Technology
Connecticut	• Agricultural Science & Technology

State & CTE Website	CTE Program Areas
(http://www.sde.ct.gov/sde/cwp/view.asp?a=2626&q=320802)	• Business/Finance Technology • Cooperative Work Education • Marketing Education • Medical Careers Education • Technology Education
Delaware (http://www.doe.k12.de.us/infosuites/ddoe/aboutdoe/workgroups/cte.shtml)	• Agriscience Education • Business, Finance, and Marketing • Skilled and Technical Sciences • Special Programs • Technology Education
Florida (http://www.fldoe.org/workforce/dwdframe/)	16 career clusters
Georgia (https://www.georgiastandards.org/standards/pages/BrowseStandards/ctae.aspx)	• Agriculture • Architecture, Communication, and Logistics • Business and Computer Science • Engineering Technology • Family and Consumer Sciences • Marketing, Sales, and Service
Hawaii (http://www.hawaii.edu/cte/)	• Arts and Communication • Business • Health Services • Industrial and Engineering Technology • Natural Resources • Public and Human Services
Idaho (http://www.pte.idaho.gov/High_School_Student.html#)	• Agriculture and Natural Resources • Business Management and Marketing • Engineering Technology Education • Family and Consumer Sciences • Health Professions • Individualized Occupational Training • Skilled and Technical Sciences
Illinois (http://www.isbe.state.il.us/career/)	• Agricultural Education • Business, Marketing and Computer Education • Engineering and Technology Education • Family and Consumer Sciences • Health Science Technology

State & CTE Website	CTE Program Areas
Indiana (http://www.doe.in.gov/achievement/career-education)	• Agriculture • Business, Marketing, and Information Technology • Cooperative Education and Internships • Engineering and Technology Education • Family and Consumer Sciences • Health Sciences • Trade and Industrial Education
Iowa (http://educateiowa.gov/index.php?option=com_content&view=article&id=1246&Itemid=3215)	• Agricultural Education • Business and Information Technology • Family and Consumer Sciences • Health Occupations Education • Information Solutions • Marketing Education
Kansas (http://www.ksde.org/Default.aspx?tabid=249)	16 career clusters
Kentucky (http://www.kde.state.ky.us/KDE/Instructional+Resources/Career+and+Technical+Education/)	• Agricultural Education • Business Education • Engineering and Technology • Health Science • Human Services • Industrial Education • Information Technology • Marketing Education • Pathway to Careers
Louisiana (http://www.doe.state.la.us/offices/careertech/)	• Agricultural Education • Business Education • Family and Consumer Sciences • General CTE • Health Science • Marketing Education • Technology Education • Trade and Industrial Education
Maine (http://www.mainecte.org/)	• Agriculture, Food, and Natural Resources • Architecture and Construction • Arts, AV Technology and Communications • Business, Management and Administration

State & CTE Website	CTE Program Areas
	• Education and Training • Finance • Health Science • Hospitality and Tourism • Human Services • Information Technology • Law, Public Safety, and Security • Manufacturing • Marketing, Sales and Service • STEM • Transportation, Distribution, and Logistics
Maryland (http://www.marylandpublicschools.org/MSDE/divisions/careertech/career_technology/)	• Arts, Media & Communication • Business, Management & Finance • Construction & Development • Consumer Service, Hospitality & Tourism • Environmental, Agricultural & Natural Resource Systems • Health & Biosciences • Human Resource Services • Information Technology • Manufacturing, Engineering & Technology • Transportation Technologies
Massachusetts (http://www.doe.mass.edu/cte/)	• Agriculture & Natural Resources • Arts & Communication Services • Business & Consumer Services • Construction • Education • Health Services • Hospitality & Tourism • Information Technology Services • Manufacturing, Engineering & Technology • Transportation
Michigan (http://www.michigan.gov/mde/0,1607,7-140-6530_2629---,00.html)	• Agriculture, Food, and Natural Resources • Architecture and Construction • Arts, AV Technology and Communications • Business Administration Management • Education and Training • Finance

State & CTE Website	CTE Program Areas
	• Government and Public Administration • Health Science • Hospitality and Tourism • Human Services • Information Technology • Law, Public Safety, Corrections & Security • Manufacturing • Marketing, Sales and Service • STEM • Transportation, Distribution & Logistics
Minnesota (http://www.cte.mnscu.edu/)	• Agriculture, Food, and Natural Resources • Arts, Communication & Information Systems • Business, Administration, and Management • Engineering, Manufacturing & Technology • Health Science Technology • Human Services
Mississippi (http://www.mde.k12.ms.us/career-and-technical-education)	• Agriculture & Natural Resources • Business, Management, Marketing & Technology • Construction & Manufacturing • Education, Hospitality, Fine Arts & Social Services • Health & Human Sciences • STEM • Transportation
Missouri (http://dese.mo.gov/divcareered/)	• Agricultural Education • Business, Marketing & Information Technology • Family and Consumer Sciences & Human Services • Health Sciences • Skilled Technical Sciences • Technology and Engineering Education
Montana (http://opi.mt.gov/programs/CTAE/CTE.html)	• Agricultural Education • Arts & Communication • Business & Marketing Education • Education/Industrial Arts • Family and Consumer Sciences • Health Sciences • Technology Education
Nebraska	• Agriculture, Food, and Natural Resources

State & CTE Website	CTE Program Areas
(http://www.education.ne.gov/nce/)	• Business, Marketing, and Management • Communication and Information Systems • Health Sciences • Human Services & Education • Skilled and Technical Sciences
Nevada (http://www.doe.nv.gov/CTE.htm)	• Agriculture and Natural Resources • Business and Marketing Education • Career Guidance • Family and Consumer Sciences • Health Science & Public Safety • Information & Media Technologies
New Hampshire (http://www.education.nh.gov/career/career/cte_programs.htm)	16 career clusters
New Jersey (http://www.state.nj.us/education/cte/)	• Agriculture, Food, and Natural Resources • Arts, AV Tech & Communications • Business, Management, & Administration • Finance • Health Sciences • Hospitality & Tourism • Information Technology • Manufacturing • STEM • Transportation, Distribution & Logistics
New Mexico (http://www.ped.state.nm.us/CTWEB/index.html)	• Arts & Entertainment • Business Services • Communications & Information • Energy & Environmental Technologies • Engineering, Construction, Manufacturing & Agriculture • Health & Biosciences • Hospitality and Tourism
North Carolina (http://www.ncpublicschools.org/cte/)	• Agricultural Education • Business and Information Technology • Career Development • Family and Consumer Sciences • Health Occupations • Marketing

State & CTE Website	CTE Program Areas
	• Technology Education • Trade and Industrial
North Dakota (http://www.nd.gov/cte/)	• Agricultural Education • Business and Office Technology • Career Development • Family and Consumer Sciences • Health Careers • Information Technology • Marketing Education • Technology Education • Trade, Industry, and Technical
New York (http://www.p12.nysed.gov/cte/)	• Agriculture • Business and Marketing • Family and Consumer Sciences • Health Occupations • Technology Education • Trade and Industrial
Ohio (http://education.ohio.gov/GD/Templates/Pages/ODE/CTELandingPage.aspx?page=836)	• Agricultural and Environmental Systems • Arts & Communications • Business & Administrative Services • Construction Technologies • Education & Training • Engineering & Science Technologies • Finance Career Field • Government & Public Administration • Health Sciences • Hospitality & Tourism • Human Services Career Field • Information Technology Career Field • Law & Public Safety • Manufacturing • Marketing • Transportation Systems
Oklahoma (http://www.okcareertech.org/)	16 career clusters
Oregon (http://www.ode.state.or.	• Agriculture, Food & Natural Resource Systems

State & CTE Website	CTE Program Areas
us/search/results/?id=151)	• Arts, Information, and Communication • Business & Management • Health Sciences • Human Resources • Industrial & Engineering Systems
Pennsylvania (http://www.careertechpa.org/)	• Advanced Materials & Diversified Manufacturing • Agriculture & Food Production • Building & Construction • Business & Financial Services • Education • Information & Communication Services • Life Sciences • Logistics & Transportation • Lumber Wood & Paper
Rhode Island (http://www.ride.ri.gov/cte/)	• Agriculture & Natural Resources • Architecture & Construction • Arts, AV, and Communications • Business & Administration • Education and Training • Finance • Government & Public Administration • Health Sciences • Hospitality and Tourism • Human Services • Information Technology • Law & Public Safety • Manufacturing • Retail/Wholesale Sales and Services • Scientific Research & Engineering • Transportation, Distribution, and Logistics
South Carolina (http://ed.sc.gov/agency/ac/Career-and-Technology-Education/)	16 career clusters
South Dakota (http://doe.sd.gov/octe/careerclusters.aspx)	• Agriculture, Food, and Natural Resources • Architecture & Construction • Education & Training • Health Sciences

State & CTE Website	CTE Program Areas
	• Hospitality and Tourism • Human Services • Information Technology • Manufacturing • STEM
Tennessee (http://www.state.tn.us/education/cte/)	• Agriculture • Business Technology • Contextual Academic • Family and Consumer Sciences • Health Science • Marketing • Technology Engineering Education • Trade & Industrial
Texas (http://www.tea.state.tx.us/index2.aspx?id=5415)	16 career clusters
Utah (schools.utah.gov/cte/)	• Agriculture • Business • Family & Consumer Sciences • Health Sciences • Information Technology • Marketing • Skilled and Technical Sciences • Technology Engineering
Vermont (http://education.vermont.gov/new/html/pgm_techhed.html)	• Agriculture and Natural Resources • Arts & Communications • Business Systems • Engineering & Technical Systems • Health & Human Services • Public Services
Virginia (http://www.doe.virginia.gov/instruction/career_technical/index.shtml)	• Agricultural Education • Business & Information Technology • Career Connections • Family & Consumer Sciences • Health & Medical Sciences • Marketing Education • Technology Education

State & CTE Website	CTE Program Areas
	• Trade and Industrial
Washington (http://www.k12.wa.us/CareerTechEd/default.aspx)	16 career clusters
West Virginia (http://careertech.k12.wv.us/)	• Agriculture, Science & Natural Resources • Arts & Humanities • Business & Marketing • Engineering & Technical • Health Science Education • Human Services
Wisconsin (http://dpi.wi.gov/cte/index.html)	• Agriculture & Natural Resources • Business & Information Technology • Family & Consumer Sciences • Health Science • Marketing Management & Entrepreneurship • Technology & Engineering
Wyoming (http://wacte.net/home/)	16 career clusters

Note. CTE program areas were identified from the respective state CTE websites.