COMPLETION OF ADVANCED HIGH SCHOOL MATHEMATICS COURSES AS A PREDICTOR OF GRADUATION RATES AMONG FIRST-TIME FRESHMEN AT CSU BAKERSFIELD

by

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This thesis has been accepted on behalf of the Department of Public Administration by their supervisory committee:

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Dedication

This thesis is dedicated to my parents, Bill and Donna Eslick. Their belief in education as an investment in the future has been part of me since birth. My mother taught me that reading books was fun and my father taught me that learning mathematics was necessary. I still read and use mathematic principles and skills every day, both at home and in my career.

Maybe more importantly, my parents always expected me to finish my education. I recently told a friend that I've wanted a master's degree longer than I've wanted any other thing in my life. And, after taking a very long route by way of marriage, babies, minimum wage jobs, and many, many night classes, I'm happy that I can finally tell them, "I'm finished." Thank you, Momma and Daddy, for the wonderful foundation!

Executive Summary

Public institutions of all kinds are being subjected to more accountability by legislators, educators, the media, and taxpayers. But, U.S. colleges and universities that once enjoyed relative freedom from accountability have been increasingly in the spotlight. In light of the recent nationwide recession and painfully slow recovery, college graduation rates are being heavily scrutinized, especially among public community colleges and universities.

This study focused on graduates of Kern High School District who enrolled at CSU Bakersfield as first-time freshmen and whether taking advanced mathematics courses improved their odds of completing a college diploma. Binary logistical regression results indicated an overall model including the rigor of students' last high school mathematics class was reliable in distinguishing between those who graduated with a bachelor's degree and those who did not. Holding all other variables constant, KHSD students taking any course(s) above Algebra 2 were 3.2 times more likely to complete college in four years. The findings held for five- and six-year college graduation rates as well. Students taking more rigorous mathematics courses were 2.2 times more likely to finish their degree in five years and 1.8 times more likely to finish their degree in six years.

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Chapter 1

Introduction

Public institutions of all kinds are being subjected to more accountability by legislators, educators, the media, and taxpayers. But, U.S. colleges and universities that once enjoyed relative freedom from accountability have been increasingly in the spotlight since the early 1990s. (Powell, Gilleland, & Pearson, 2012; Selingo, 2012) College completion is currently a central topic of discussion in the public conversation at all levels -- national, state and local. In light of the recent nationwide recession and painfully slow recovery, college graduation rates are being heavily scrutinized, especially among public community colleges and universities. Counts of students entering the doors and participation rates in outreach and support programs are no longer sufficient to demonstrate that public subsidy of higher education is producing a well-educated and work-ready labor force. Certainly, a college degree remains one of the only signals that an individual is ready for the job market (Selingo, 2012) and a predictor of life-long success (Nicholson, 1973).

Measuring Success with Graduation Rates

For nearly two decades federal and state legislatures have been demanding greater accountability among institutions of higher education. Graduation rates are being used increasingly as an important measure of institutional success, especially when everyone -- students, parents, educators, legislators, the media – are expecting greater accountability for educational outcomes. (Bailey, 2006; Goenner & Snaith, 2004; Powell, et al., 2012). Powell et al. identify the key stakeholders in the situation:

> The federal government, state governments, students, and their families all make significant investments in higher education. The investments take different forms: from

> providing financial aid to students as a subsidy for their tuition costs to providing funds directly to institutions for their operations. Whatever the source or form, each of these constituencies has a stake in how their funds are used and the results achieved. (p. 103)

Scrutiny of postsecondary graduation rates in Kern County is particularly well founded due to its astonishingly low rates of community college and university completion. Among the 100 most populated Metropolitan Statistical Areas (MSA) in the United States, the Bakersfield-Delano MSA (equivalent to the County of Kern) ranked 99th in the number of adults aged 18 to 64 with at least an associate's degree. Additionally, among California's 52 counties, Kern ranked 47th. (Lumina, 2012) Additionally, among the nation's 372 Metropolitan Areas, Bakersfield-Delano MSA is the 10th worst in terms of unemployment. (U.S. Bureau of Labor Statistics, 2012) With only 21.33 percent of working-age adults holding at least a community college degree, Kern County will certainly continue to have one of the highest unemployment rates in the nation.

Stakeholders' need for accountability among institutions of higher learning is reflected in the evaluation standards of national accrediting bodies. Accrediting institutions not only partner with colleges on assessment and outcomes, they hold the keys to federal funding. Without accreditation, Pell grants, federal student loans, Title IV monies and other significant funding for the institution and its students are withheld. Hinton (2009) asserts that although postsecondary accrediting organizations are actively promoting learning outcomes among colleges and universities, the public must also hold institutions accountable for outcomes and graduation rates.

Public Funding: Buying Access or Successful Outcomes?

The U.S. Department of Education (2011) acknowledges that "fewer than half of those who begin postsecondary training earn a certificate or degree within six years of initial

enrollment" (p.2). They point to inadequate financial resources as part of the problem and encourage individuals and organizations to pressure state lawmakers to revise out-of-date funding systems. Since most states fund public higher education based on student enrollment rather than rates of completion, public colleges and universities are essentially being rewarded for student turnover rather than student graduation. (U.S. Department of Education)

Colleges and universities, viewed as a public good, have historically been allowed to operate with few inquiries into their expenses or the results they achieve from available resources. (Powell et al., 2012) But times are different now and resources for higher education, both public and private, are increasingly limited. California State University (2012), the nation's largest public university system, is currently funded at 1998 levels while serving approximately 72,000 more students than it did at that time and more cuts are expected in 2012-13.

With system budgets dwindling, universities are seeking more funding from private education foundations like the Bill & Melinda Gates Foundation and the Lumina Foundation for Education. But organizations like these are no longer focusing on simple access to higher education. They are measuring success by a completed college degree for each enrolled student. These efforts among private foundations are a result of increasing public frustration at the amount of tax and tuition dollars being spent on postsecondary education compared to the number of individuals actually completing their college degree. Evidence of this frustration can be seen in an editorial printed in USA Today (2009):

> Too many schools seem obsessed with bringing students in, then seem to lose interest in what happens after they are admitted. With so much money being wasted in futile pursuits of degrees, colleges need to work harder to improve their graduation rates, especially for minority, male and low-income students who are particularly at risk…

> Schools that fail to improve ought not to be treated kindly by the academic marketplace. Parents and students should check a college's rate before spending thousands of dollars there. State and federal departments of education ought to monitor graduation rates and press for improvements. (p. 8A)

In 1990, Mortenson and Wu published a study on high school graduation, college participation, and baccalaureate degree attainment for the American College Testing Program. It covered the years 1970 to 1989 and was primarily focused on the benefit of financial aid. Their study found that college completion was directly impacted by family income but that "massive federal investments in educational opportunities for low family income students through Title I of the Elementary and Secondary Education Act and Title IV of the Higher Education Act did not produce evidence of broad and substantial success" (p. xix). The authors found no increase in the level of degree attainment among disadvantaged students and no evidence of sustained improvement in education outcomes for these students related to federal funding. One of their conclusions is as true today as it was in 1990:

> Evidently, the key to increasing the participation of disadvantage students in higher education goes beyond additional funding for the K-12 system and funding for college expenses. While such funding is obviously necessary for these students who lack financial resources to pay these bills, it will take more than money to accomplish the worthy public policy goal. (p. xiii)

Economic and Political Pressure for Improved College Graduation Rates

For the individual completing a college degree, the economic benefits are well documented. The U.S. Census Bureau (2002) reports that individuals completing a bachelor's degree earn nearly $1.0 million more over their careers that those who only have a high school

diploma. And the wage gap between these two populations is widening. In 1975, individuals with bachelor's degrees earned 1.5 times the annual wage of high school-only graduates and by 1999 the ratio increased to 1.8. Tinto (2004) notes that the gaps in wages and unemployment rates are nearly as large for those who began but did not finish college and those who never started in the first place. Selingo (2012) also stated that students who enroll in college but do not finish can even be worse off than those who never began if they took on student loan debt.

Education benefits, in terms of higher earnings, apply not only to individuals but to the businesses employing them. These both lead to increases in tax revenue for all levels of government. On average, each person earning a bachelor's degree generates $5,900 more per year in state, federal, and local tax revenue than each high school graduate. Over a lifetime, each generates, on average, $177,000 more in tax revenue than those with only a high school degree. These figures reflect an economic imperative for states to increase the number of college graduates over the next 10 years. (U.S. Department of Education, 2011)

The Lumina Foundation for Education (2012) summarizes the situation: "Policymakers, economists and other experts agree that, in order to sustain the still-fragile recovery and assure long-term economic growth and social stability, the nation's educational attainment rate must improve steadily and significantly in coming years" (p. 2). In February 2009, during his first joint address to Congress, President Obama identified increasing college graduation rates as a national goal. The President's vision is to "once again have the highest proportion of college graduates in the world by the year 2020" (U.S Department of Education, 2011a, p.1) To fulfill this goal, the proportion of college graduates in the U.S. must increase by 50 percent – or eight million more degree-holders nationwide. Although wrapped in national pride, the mission to

increase graduation rates is tied to economic growth and prosperity both for the individual and the country.

To place political pressure for states to participate in this goal, the Obama Administration released the Complete College Tool Kit published by the Department of Education in 2001. The Tool Kit, designed for governors, identified each state's share of the President's 2020 goal and suggested policy changes that would help increase states' college graduation rates. The companion document to the Tool Kit also provides the number of new college graduates each state needs to contribute for the U.S. to achieve this goal; California is expected to produce an additional 1.6 million college graduates before 2020. It is interesting to note that states having already implemented targets for meeting their "assigned" college graduation goals were also identified in the companion document and, at the time of publication, California did not appear on this list. (U.S. Department of Education, 2011a)

Why Predict College Graduation Rates?

Bailey (2006) correctly states that institutional researchers are often called on to work with graduation rates because "an institution's predicted graduation rate provides additional meaningful information and lends itself readily to the practice of benchmarking for identifying comparable segments of institutions in order to understand graduation rates in meaningful and appropriate contexts" (p. 101). As an institutional researcher at CSUB, I often report graduation rates to others. As part of the larger CSU system, our campus is currently participating in initiatives focused on improving graduation rates, including Access to Success and Complete College America. Gathering data for these initiatives is a key component of my work in the Institutional Research, Planning, and Assessment (IRPA) office. However, our expanding advisory duties for CSUB's President and Provost now require more than reporting numbers.

Administrative focus on data driven decision-making and policies demand a more complete understanding of university graduation rates. This research study will inform the President and Provost and their collaborative partners about what impacts graduation rates and contribute to discussions about new strategies for improving them.

On a personal level, I also wanted to know more. As a graduate of a local high school and an undergraduate alumna of CSUB, I considered whether advanced mathematics classes throughout high school influenced my persistence over 10 years to complete my bachelor's degree.

In gathering literature for this study, I was especially intrigued by the research of Adelman (1999, 2004, 2006), Sciarra (2010), and Rose and Betts (2001). The inclusion of high school mathematics curriculum in their predictive models seemed unique among the plethora of literature focused on either socioeconomic factors or supportive college environments. Their models did not focus primarily on factors that CSUB and its education partners can do nothing about (students' gender, race/ethnicity, family income, first generation status, etc.) or support programs designed to help less advantaged students after they arrive in the university setting. They focused on academic preparation before the student arrives on the college campus. I was interested in this type of model—one that would help our education partners assist less advantaged students and successfully influence their college graduation rates while they were still in high school.

This study will contribute to both public administration and education literature in the matters of public accountability, high school and college reform efforts and mathematics curriculum alignment between secondary and postsecondary institutions. I believe this modest contribution will add to the body of work so succinctly described by Rose and Betts (2001).

> From a policy perspective, a clear understanding of the effects of math courses is extremely important…to intervene in education effectively, we must understand whether students' destinies have been determined by the time they reach high school or whether a rigorous high school curriculum can alter students' paths. If it turns out that high school has little influence over student outcomes, intervention is necessary at an earlier stage. On the other hand, if high school curriculum does affect educational and labor market outcomes, policies aimed at encouraging students to take a more advanced curriculum may be a way of increasing the flow into college and increasing student earnings later in life. (p. viii)

In light of Bailey's (2006) admonition for meaningful information suitable for benchmarking and given the importance of college completion and the need for data-driven university policies Therefore, this applied research study will investigate whether advanced high school mathematics curriculum will successfully predict graduation rates at CSUB and produce the odds of first time freshmen graduating with a bachelor's degree. The study will also investigate whether various socioeconomic variables contribute or detract from the academic preparation model.

Chapter 2

Literature Review

The vast majority of research and published literature define the problem of low graduation rates as a reflection of students' various socioeconomic categories. Income and race/ethnicity research has been the most prevalent since the 1960s, but in recent years more publication has occurred on the subject of parental education and students' status as "first generation" college students.

Key Research on College Graduation Rates and Public Policy

Tinto is undoubtedly referenced most often in higher education literature related to college persistence. He has published throughout his career, authoring many papers, conducting research for various government and foundation organizations, and writing many books on the subject of college completion. His earliest works referenced in the Education Resource Information Center (ERIC) database were published in the early 1970s. (Tinto, 1973; Tinto & Cullen, 1973; Tinto & Sherman, 1974).

Most of his publications focus on income, race/ethnicity, and appropriate interventions for less advantaged students at the college level. Although he does comment on academic preparation, it is usually in the context of differences between students of various income levels or races. He has become an advocate in education and public policy circles for improving student support services on college campuses and keeping the problem of education disparity in the public eye.

Tinto's extensive research cannot be disregarded. His early work on trends in college persistence and completion especially highlights differences among various socioeconomic groups. These issues have not disappeared. A 2011 report by the U.S. Department of Education states: "Despite substantial investments in higher education over the last 40 years, the percentage

of Americans with a postsecondary degree or credential is only modestly higher than it was in 1970" (p.20). This statement is reminiscent of the conclusions drawn by Mortenson and Wu. College completion rates nationwide continue to vary by family income levels. According to the National Center for Education Statistics (NCES), 30 percent of low-income students will leave postsecondary education without a degree, compared to only 12 percent of high-income students. (National Center for Education Statistics, 2009)

Tinto's recent work usually describes postsecondary interventions that are most successful in supporting less advantaged students as they move through college and asserts that the responsibility of assisting these students falls to the college institution.

> Access without support is not opportunity. That institutions do not intentionally exclude students from college does not mean that they are including them as fully valued members of the institution and providing them with support that enables them to translate access into success. Too often our conversations about access ignore the fact that without support many students, especially those who are poor or academically underprepared, are unlikely to succeed. Little wonder then that our gains in access have not closed the gap in four-year degree. (Engstrom & Tinto, 2008, p.50)

However, Astin (1993) observed that college retention rates are attributable to students themselves, rather than on their campus experiences. He found more than half of the variance in institutional graduation rates could be attributed to student-related data. Liang (2009) acknowledged that the study of graduation data "has been heavily influenced by Tinto's (1993) interactionalist model of student persistence" (p. 716), but chose rather to focus on the financial resources of public colleges and found some positive association.

Adelman (1999) has taken issue with the college's full responsibility for whether students graduate. While working for the U.S. Department of Education, Adelman (1999) was motivated by the growing use of graduation rates as accountability measures and "the tendency in public policy and opinion to blame colleges for students' failure to complete degrees and/or failure to complete degrees in a timely manner" (p. v). In the 1999 study, Adelman found that the key predictors were most related to students' academic preparation in high school and attendance patterns once in college. While other researchers were focusing on race and income, Adelman found that socioeconomic predictors contributed only a little to the entire college graduation picture and, specifically, race was not a predictive factor. "No matter how many (and in different formulations) we try to introduce race as a variable, it does not meet the most generous of threshold criteria for statistical significance" (p. vi). However, the effect of intensive academic preparation was more pronounced for students of color than any other pre-college indicators. His study found that income and racial differences in college completion rates are smoothed away by students completing higher mathematics courses in high school.

Adelman's co-mingling of academic rigor and public policies were foundational to this research study. He found that

1. Advanced high school mathematics courses improve the odds of any student completing college regardless of socioeconomic barriers, and

2. Collaborations between high schools and college are not useful for improving college graduation rates unless they include discussions about—and changes to—mathematics curriculum and students' course-taking patterns while in high school.

Adelman continued his work on high school mathematics and the intensity required for the most benefit in college. He found that students' final high school mathematics level was the

one consistent predicator of college preparedness and that being prepared for college meant taking courses beyond Algebra 2. He also learned that the more time that elapses between mathematics courses can be critical (Adelman, 2006). This finding has particular policy implications related to the CSU/UC entrance requirements ("A-G" requirements). Currently, a student can pass Algebra 1 in junior high school and take Geometry and Algebra 2 during high school and still technically meet the mathematics criteria for entry to the CSU or UC systems. (University of California, 2012) The possibility for high school students to "skip" mathematics for one or two years of high school and still be eligible for admission may be part of the reason students struggle during freshmen mathematics classes.

The research of Rose and Betts (2001) is unique among the literature I found, in that they analyzed mathematics in high school as a predictor of college completion and also as a predictor of future earnings. They used a logistic regression model similar to Adelman (1999) for the study. "Our statistical analyses predict that taking a richer math curriculum in high school does indeed increase both the probability of graduating from college and earnings about a decade after the end of high school" (Rose & Betts, 2001, p. 76). They concluded that secondary curriculum has not only an indirect effect on future earnings (by affecting whether students attend college and complete their bachelor's degree) but also acts as a predictor of future earnings independent of students' final level of educational attainment.

Rose and Betts (2001) also reiterated the message of Adelman's research (1999): taking just any set of mathematics courses does not contribute to the predictive nature of the variable. Progressively more rigorous courses have a much larger predictive effect on both college graduation rates and future earnings.

Sciarra (2010) added to the literature by focusing on the differences in course-taking pattern among various groups. He also created a logistic regression model similar to the one used by Adelman in 1999 using a categorical dependent variable that differentiated high school students who completed at least one course beyond Algebra 2 from those who completed a course in Algebra 2 or less. He found that various factor influence whether students' access higher level mathematics courses in high school, including, race/ethnicity, gender, first-generation status, and student/parental aspirations and expectations.

> As for student expectations, those students who expected to complete less than a baccalaureate degree were more than 4 times less likely (odds = 4.23) to complete a course beyond Algebra 2 than those who expected to complete a baccalaureate degree or higher. The same is true for parent aspirations though to a lesser degree. Students whose parents wanted them to complete less than a baccalaureate were a little over 2 times more likely (odds = 2.30) to complete a course in Algebra 2 or less than those whose parents wanted them to complete a 4-year college degree. (Sciarra, 2010)

Horn et al, (2001) also found that students' rigor in high school courses was strongly related to persistence toward the bachelor's degree. He further found that the relationship held for those who continued at the first postsecondary institution and those who transferred to another institution to complete the degree.

Research-Based Variable Selection

Many researchers have contributed to the body of literature surrounding graduation rates by investigating a diverse set of variables that may fully or partially account for variances in student outcomes.

- Student demographics (e.g. gender, race/ethnicity and/or family income (Ganderton & Santos, 1995; Mortenson & Wu, 1990);
- Tuition costs and financial aid policies (DesJardins & McCall, 2010);
- College characteristics (e.g. size, location, religious affiliation) (Koker & Hendel, 2003);
- State funding levels of public colleges (Liang, 2009);
- Student body characteristics and college selectivity (Alon & Tienda, 2005);
- High school academic counseling efforts (Sciarra, 2010);
- High school course-taking patterns (Adelman, 1999, 2006; Rose & Betts, 2001);
- Curriculum alignment between high schools and colleges (Adelman, 2008);
- Students' perceptions about themselves (e.g. cognitive functioning, aspirations, expectations, self-ratings, values and attitudes, behavioral patterns (Astin, 2005);
- Students' choice in college major (Porter & Umbach, 2006); and
- Parental education levels and student' first-generation status (Ishitani, 2005; Warburton, 2001).

With so many different interactions being studied by so many researchers, choosing appropriate variables for a college completion study can be overwhelming. Certainly, theory should guide the choice of variables, but no single theory seems to explain the complex nature of higher education outcomes. Goenner & Snaith (2004) found that researchers and policymakers alike are often uncertain about which factors are truly causal in graduation rates.

Of all the many influences found in these variables, only some are under direct control of policymakers. Public policies certainly cannot dictate students' race/ethnicity, gender, parents' education, or family income levels. (Although financial aid can help mitigate a financial inability

to attend college, this is more about access than completion.) And, they probably have little to do with students' values, aspirations, and cognitive functioning.

Elected decision-makers certainly can control what kinds of public colleges and schools are built and where they are located, but again, this seems to be more about students' access to education rather than completion. However, Liang (2009) has made a compelling case for the influence of public funding policies on graduation rates. In California, the public funding variable at both the secondary and post-secondary level can be manipulated by legislation, executive order, or voter referendum.

Most variables at the secondary level can be manipulated by changes in public policy. These include high school curriculum availability, graduation requirements (e.g. number of units, exit exam), some aspects of academic counseling (e.g. required information distribution; increased number of high school counselors), and course content alignment with freshman college courses.

In public post-secondary institutions, however, elected decision-makers have less influence due to the historical considerations of tenure, academic freedom, and shared governance. Beyond state funding, elected officials can realistically influence admission and enrollment management practices on public college campuses. (CSU Sacramento, 2001) Academic Senates and other faculty committees have significantly more control of post-secondary academic policies and practices.

Correlation and Causation among Variables

It is evident from the available literature on college graduation rates that a strong positive correlation exists between the taking of advanced mathematics courses in high school and the completion of a bachelor's degree. Adelman (1999) found that completing one course beyond

Algebra 2 more than doubled the odds of completing a bachelor's degree and Trusty and Niles (2003) found that taking more intensive math courses in high school increases the likelihood of completing a college degree. And, as previously noted, Rose and Betts (2001) found a strong positive correlation between students' mathematics courses in high school and both their college attainment and future earnings.

Although correlation is necessary for causation, it does not prove it. This can occur only through experimental research design. (Mertler & Vannatta, 2001) Since the ethics of randomly assigning high school students to various mathematics tracks are suspect, it is unlikely that true causality can be determined for college graduation rates. However, Rose & Betts (2001) did further control for various demographics, mathematics GPA, and 10^{th} grade mathematics test scores in an attempt to assure that motivation or natural ability were not the underlying reasons for the correlation. They concluded that the course-taking effect did not simply measure variations in ability, motivation, or family background.

Additionally, the National Center for Education Statistics has determined that the effect of rigorous mathematics courses is important enough in explaining college graduation rates they have recently included them as a variable in their online table builder, QuickStats (2009). Therefore, I have concluded that strong correlation between one or more independent variables and the dependent variable of college completion will be sufficient for the purpose of creating a predictive model.

Hypothesis

After reviewing the relevant literature and research designs, I have hypothesized that taking rigorous high school mathematics courses will improve the odds of KHSD students graduating college with a bachelor's degree.

Chapter 3

Methodology

Data collection

A database compiled from the records of both KHSD and CSUB was needed to implement this research project. Due to my position in Institutional Research at CSU Bakersfield (CSUB), college admissions and enrollment data on students at the university was readily available and accessible for this study under appropriate IRB protocols. The Assistant Vice President of Institutional Research, Planning, and Assessment agreed to cosign the IRB request.

Graduation data, however, can be easily gathered only if students complete the undergraduate degree at CSUB. Therefore, an alternative source had to be found for students transferring to other colleges. To facilitate the collection of this data, StudentTracker services were considered.

The National Student Clearinghouse makes student level data available via StudentTracker to institutions that participate in degree verification and other services. CSUB does have a contract with the National Student Clearinghouse for these services and graduation data for all students can be gathered electronically if they completed the bachelor's degree at another institution that also participates in these services. According to the National Student Clearinghouse website, 96 percent of all public and private colleges and universities in the United States provide graduation data on their students to Student Clearinghouse (2012). If students enrolled at CSUB completed their degree at one of these colleges, the resulting data can be made available electronically for purposes of institutional research.

Unfortunately, high school academic preparation variables, beyond GPA and test scores, are not currently part of the data collected by CSUB. Although student transcripts are imaged for admissions purposes, the data is not housed in a format suitable for longitudinal analysis.

Since hand review of each student's transcript was not a feasible option for this study, information about courses taken and grades earned needed to come from the databases of multiple high schools or district offices. For access to this data, strong relationships were required with high school administrators and database managers and programmers. Due to the relative ease of developing a collaborative partnership with one district rather than many individual high schools and the fact that KHSD is the largest feeder school for CSUB, I chose to restrict this study to the incoming freshmen from KHSD. (CSUB, 2005) This type of restriction is not without precedent in studies of high school course-taking patterns (Roth, et al, 2000).

To initiate the collaborative partnership, I contacted a peer researcher with the Research and Planning Office at KHSD. He agreed to open the conversation with the Director and we began an email discussion about the possibilities of sharing data between our two institutions. In addition to CSUB's interest in graduation rates, KHSD was interested in understanding the remediation needs of its graduating students. A compiled dataset would meet the needs of both institutions and the partnership was begun. A research protocol was approved by the Institutional Review Board at CSUB and the process of sharing student data between institutions began in March 2010.

Data was collected under IRB Protocol #10-30 from both CSUB's Enrollment Reporting System (ERS) and, with the help of computer programmers at KHSD, the high school district's student data system. The ERS dataset included information on all students who both applied and were admitted to CSUB prior to high school graduation and subsequently enrolled in classes the following college year. Information gathered from CSUB included college application data provided by the student, high school GPA, SAT/ACT test scores, admission decisions by college transcript evaluators (including the need for first year remediation in mathematics, English, or

both), attendance records (if any) for each Fall term following admission, and freshmen course patterns in mathematics and English.

The KHSD dataset included demographic information, the high school attended at graduation, National School Lunch Program participation records, junior and senior course patterns and grades for both mathematics and English, and a variable indicating whether students successfully completed the course pattern required for admission to the CSU/UC systems (commonly referred to as the A-G requirements).

The IRB protocol covered the use of Social Security Numbers (SSNs) as the linking variable between these two datasets, which were combined to create a set of data that included 93 percent of graduating students from KHSD from 2005 through 2009 who also enrolled at CSUB immediately after graduation. (Approximately 170 students over the five year period were not matched due to the lack of SSNs.) The final data set included high school and college information on 2,468 incoming freshmen to CSUB.

Finally, I utilized Student Clearinghouse to determine which students had graduated with a bachelor's degree during the intervening years since matriculation. Students may have graduated from either CSUB or any other college participating in Clearinghouse services. Dummy variables were created in the dataset to identify degree completion within four, five, or six years from matriculation.

As part of the initial agreement with KHSH, this complete combined dataset is available for long-term study by both CSUB and KHSD researchers. However, a smaller subset of the data (with removal of potentially identifying information and extraneous variables and the addition of needed dummy variables for the regression analysis) was created for the purposes of this study. Frequency distributions summarizing the data are presented in the following tables.

Table 1. Total population of Kern High School District graduates attending CSU Bakersfield as first-time freshmen by year of college matriculation and high school institution of origin

	(#)	(%)
Total Population	2468	100.0
College Year		
2005-06	453	18.4
2006-07	458	18.6
2007-08	453	18.4
2008-09	484	19.6
2009-10	620	25.0
High School Institution of Origin *		
Arvin	194	7.9
Bakersfield	143	5.8
Centennial	176	7.1
East	117	4.7
Foothill	180	7.3
Frontier	27	1.1
Golden Valley	50	2.0
Highland	89	3.6
Liberty	240	9.7
North	162	6.6
Ridgeview	248	10.0
Shafter	133	5.4
South	256	10.4
Stockdale	256	10.4
West	197	8.0
Unknown (Missing)	0	0.0

** For the purposes of this study, Kern River Valley High School was removed from the KHSD study population due to the number of students attending CSUB from this school. The low numbers would have made it potentially possible to identify individual students during the analysis.*

Table 2. Demographic summary of Kern High School District graduates attending CSU Bakersfield as first-time freshmen

	(#)	(%)
Total Population	2468	100.0
Gender		
Female	1639	33.6
Male	829	66.4
Race/Ethnicity		
African American or Black	128	5.2
Asian or Pacific Islander	127	5.2
Caucasian or White	615	24.9
Hispanic or Latino	1093	44.3
Native American	18	0.7
Two or More Races	14	0.5
Non-Resident Alien	10	0.4
Unknown (Missing)	463	18.8
Minority Status *		
Underrepresented Minority (URM)	1239	50.2
Not Underrepresented Minority (non-URM)	742	30.1
Unknown (Missing)	487	19.7
Income (based on NSLP participation) **		
Low Income	1163	47.1
Not Low Income	1305	52.9
First Generation Status ***		
First Generation College Student	1088	44.1
Not First Generation College Student	1359	55.0
Unknown (Missing)	21	0.9

** Underrepresented minority (URM) students have identified themselves as Black or African American, Hispanic or Latino, or Native American. All other students are considered non-URM.*

*** NSLP is the federal National School Lunch Program for families considered low income. This variable is used as a proxy for family income level.*

**** For the purposes of this study, "First Generation College Student" is defined as a college freshmen who has no parent that attended college*

Table 3. High school academic summary of Kern High School District graduates attending CSU Bakersfield as first-time freshmen

	(#)	(%)
Total Population	2468	100.0
High School GPA		
Mean = 3.289, SD=.4834, Range 1.771 to 4.500		
4.0 and Above	201	8.1
3.0 - 3.9	1573	63.8
2.0 - 2.9	692	28.0
Under 2.0	2	0.1
SAT Math Test Scores		
Mean = 466.87, SD=90.717, Range 200 to 790		
700-800	5	0.2
600-699	167	6.8
500-599	540	22.0
400-499	827	33.5
300-399	360	14.6
200-299	51	2.1
Took ACT Only	255	10.3
Did not take SAT or ACT	263	10.7
Preparation for CSU/UC Entry		
Completed A-G Requirements	1820	73.7
Did Not Complete A-G Requirements	648	26.3
Preparation for College Math		
No Remediation Needed	985	39.9
Remediation Needed	1483	60.1
Math Experience During Senior Year		
Took Any Math Course During Senior Year	1905	77.2
Did Not Take Math Course During Senior Year	563	22.8
Math Rigor During Junior or Senior Year		
Successfully Completed Course(s) Beyond Algebra 2	1630	66.0
Did Not Complete Course(s) Beyond Algebra 2	807	32.7
Unknown (Missing)	31	1.3

Research Design

This research study was longitudinal and non-experimental in nature, covering students' entry to college from 2005-06 through 2009-10. Because I chose to study the entire population of KHSD students who entered CSUB as first time freshmen, I was not concerned with sampling procedures.

My primary interest focused on two possible final outcomes—whether a bachelor's degree was earned or not—therefore, I chose a binomial logistic regression method to estimate the probability of graduating. This model is designed to predict probabilities within a range of 0 to 1 and is similar to the one used by Adelman (1999) and Rose and Betts (2001). Although logistic regression is similar to both multiple regression and discriminate analysis, it provides distinct advantages over both techniques.

Particularly, logistic regression requires no assumption about the distributions of the predictor variables. They do not need to be normally distributed, linearly related, or have equal variances within each group. Additionally, the predictor variables can be continuous, discrete, or dichotomous. Logistic regression will specify the probabilities of a particular outcome—essentially a "pass" or "fail"—for each subject or case involved. The produced regression is designed to accurately predict the probability of whether an individual or case falls into one category ("pass") or the other ("fail"). (Mertler & Vannatta 2001; Tate, 1992) I used the Statistical Package for the Social Sciences (SPSS) for this statistical analysis.

Table 4. Student characteristics accounted for in the college graduation rate probability model

Probability that a student matriculating in 2005/06 completed a bachelor's degree within 6 years	=	F (math curriculum rigor, demographic & socioeconomic information, parent education levels, student motivation) where F is a non-liner function of the following dichotomous variables:
Math curriculum	=	Rigor of last high school mathematics course
Demographic & socioeconomic information	=	Minority status, gender, participation in the National Student Lunch Program (proxy for income level)
Parental education	=	Postsecondary experience of at least one parent
Student motivation	=	Any mathematics taken during senior year

(Rose & Betts, 2001)

Logistic Regression

In the logistic regression application, the odds of any occurrence (*i*) happening is defined as the ratio of the probability (*p*) it will occur divided by the probability that is will not (1-*p*), or:

$$\text{Odds}_i = \frac{p(X)}{1-p(X)}$$

This odds ratio is often expressed as Exp(B) and when measuring the effect of independent variables on a dichotomous outcome, it is defined as the probability of being in one category or the other. (Mertler & Vannatta, 2001).

Therefore, in SPSS, the Exp(B) output from my proposed logistic regression processes will be the odds of being in the "Graduated" category or the "Not Graduated" category. It is important to note that "probabilities will always have values that range from 0 to 1, but odds may be greater than 1" (p. 318).

Odds ratios near 1.0 demonstrate that the odds of being in one category or the other are about 50/50 and there is no real predictive advantage in knowing the value of the independent variable. Odds ratios near 2.0 demonstrate that the odds of being in one category or the other are nearly doubled.

Because of having a larger number of cases available for analysis (1,341 cases had the opportunity to graduate in four years or less), I first used the binomial logistic regression process to determine which of the independent variables were best correlated with degree completion in four years. The variables were added in a forward stepping method which allows the SPSS software to start with one variable and keep adding additional variables the until no further significant addition to the model is found. The regression coefficients and odds ratios are presented for the last step in Table 5.

Table 5. Logistic regression coefficients for 4-yr graduation rate analysis (Step 3)

n=1192 included cases	*B*	*Wald*	*df*	*p (sig)*	*Exp(B)*
Independent variables:					
MATH ABOVE ALGEBRA 2	1.151	34.407	1	0.000	3.163
GENDER	0.761	18.324	1	0.000	2.141
INCOME	0.516	10.158	1	0.001	1.676
CONSTANT	-3.180				
MINORITY (removed at Step 3)					
PARENT EDUCATION (removed at Step 3)					
MATH SENIOR YEAR (removed in Step 3)					
Model goodness-of-fit measures:					
-2 Log Likelihood		1084.197			
Chi-Square		0.000			
Percentage of variation predicted by the model		81.1			

After running this model for the four-year graduates, I used the same logistic regression analysis procedure on the five-year and six-year graduates. This process removed one and two cohort(s) from the dataset, respectively. The last step regression coefficients and odds ratios are presented in Tables 6 and 7.

Table 6. Logistic regression coefficients for 5-year graduation rate analysis (Step 3)

n=781 included cases	*B*	*Wald*	*df*	*p (sig)*	*Exp(B)*
Independent variables:					
MATH ABOVE ALGEBRA 2	0.775	20.591	1	0.000	2.171
GENDER	0.332	4.135	1	0.042	1.394
INCOME	0.354	5.094	1	0.240	1.425
CONSTANT	-1.513				
MINORITY (removed at Step 3)					
PARENT EDUCATION (removed at Step 3)					
MATH SENIOR YEAR (removed in Step 3)					
Model goodness-of-fit measures:					
-2 Log Likelihood		996.262			
Chi-Square		0.000			
Percentage of variation predicted by the model		63.1			

Table 7. Logistic regression coefficients for 6-year graduation rate analysis (Step 2)

n=396 included cases	*B*	*Wald*	*df*	*p (sig)*	*Exp(B)*
Independent variables:					
MATH ABOVE ALGEBRA 2	0.574	6.26	1	0.012	1.775
INCOME	0.555	6.26	1	0.009	1.742
CONSTANT	-.800				
GENDER (removed at Step 2)					
MINORITY (removed at Step 2)					
PARENT EDUCATION (removed at Step 2)					
MATH SENIOR YEAR (removed in Step 2)					
Model goodness-of-fit measures:					
-2 Log Likelihood		532.616			
Chi-Square		0.000			
Percentage of variation predicted by the model		51.5			

Chapter 4

Results

Findings

Odds of completing college in four year.

Binary logistical regression results suggest an overall model of three variables (rigor of last high school mathematics class, family income, and gender) appears to influence the likelihood of graduating with a bachelor's degree in four years. Holding all other variables constant, KHSD students taking any course above Algebra 2 are 3.2 times more likely to complete college in four years. Gender and income were also predictors of graduating college in four years, with odds ratios of 2.2 and 1.7, respectively. The effects of gender and income were substantial, but a curriculum of rigorous mathematics was the strongest predictor of college completion at four years due to having the largest odds ratio. Minority status, parent education and taking mathematics during the senior year were removed at step 3 of the variable-introduction process. The software found these variables added no significant change to the model.

Odds of completing college in five years.

Regression results also indicated an overall model of the same three variables (rigor of last high school mathematics class, family income, and gender) appears to influence the likelihood of graduating with a bachelor's degree in five years. Holding all other variables constant, KHSD students taking any course above Algebra 2 were 2.2 times more likely to complete college in five years. Gender and income were also predictors of graduating college in five years, with each having an odds ratio of 1.4. Again, a curriculum of rigorous mathematics was the strongest predictor of college completion at five years due to having the largest odds

ratio. Minority status, parent education and taking mathematics during the senior year were again removed at step 3 of the variable-introduction process because the software found them to add no significant change to the model.

Odds of completing college in six years.

Regression results indicated an overall model of two variables (rigor of last high school mathematics class and family income) appears to influence the likelihood of graduating with a bachelor's degree in six years. Holding all other variables constant, KHSD students taking any course above Algebra 2 were 1.8 times more likely to complete college in six years. Income was also a predictor of graduating college in six years and the effect was approximately equal at 1.7 times.

It was interesting to see gender fall out of the predictive model at six years, however, having a smaller dataset (400 cases) may have impacted the analysis. The four-year model has the advantage of a much larger sample size (1,192 cases). Correlation statistics indicate that gender is related to both income and rigor in mathematics for the population of first time freshman attending CSUB from Kern High School District. It was also notable that parent education and minority status did not appear to be significantly correlated with the likelihood of graduation at any time interval. This is contradictory to the findings of most researchers on this subject. A strong correlation exists between parent education, minority status and family income levels; this may have affected the analysis. Teasing out the interaction between gender, income, minority status, and parent education bears additional study.

Comparative rates of graduation.

Tables 8 presents the comparative rates of graduation for KHSD students matriculating at CSUB in Fall 2005 and the students followed nationwide as part of the Beginning Postsecondary Student Study conducted by the National Center for Education Statistics (2009). The most recent data available from the nationwide study is for students who matriculated in 2004. Tables 9 and 10 (found in the Appendix) present the six-year graduation rates for various demographic, socioeconomic, and academic categories.

Table 8. Local and national graduation rates for students graduating in six years with a bachelor's degree from any college by highest mathematics course in high school

Graduation rates for first-time freshmen	CSUB first-time freshman from KHSD in 2005 (%)	Nationwide first-time freshmen in 2004* (%)
Total	47.5	38.8
Highest level of mathematics:		
Calculus	57.1	65.2
Pre-Calculus (Math Analysis)	53.2	47.2
Statistics	44.7	n/a
Algebra 2	36.8	32.2
Below Algebra 2	30.0	25.3

**Source: U.S. Department of Education, National Center for Education Statistics, BPS:2009 Beginning Postsecondary Students Computation by NCES QuickStats on 3/5/2012*

I was also interested to see that KHSD had much higher rates of college completion overall than students nationwide; this appears to be driven by the higher rates for those taking Algebra 2. This finding may be related to mathematics remediation efforts at CSUB. The university's Admissions office hosts intensive summer programs for those not scoring well on an Entry Level Mathematics test and those who still struggle can take additional remedial courses

during the regular terms. Investigating the effects of remediation support on graduation rates at CSUB also bears further study.

Discussion of policy implications

Given the findings in support of the hypothesis that graduation rates can be predicted by rigor in high school mathematics courses, public policy implications can be made. Since Horn et al. (2001) confirmed that socioeconomic factors, including family income and parental education, do affect whether students take higher levels of coursework, reforms at the high school level may best serve all students. Warburton et al. (2001) also found a negative association between students' parental education level and the likelihood that students would take a rigorous high school curriculum and, consequently, enroll, perform well, and persist in college. However, first-generation students were as likely as their peers to have attained a degree when they had completed advanced mathematics courses in high school.

This research implies that intervention with less advantaged students is successful if it impacts the rigor of high school mathematics. Assuring students have access to high-level mathematics courses and are encouraged to enroll in them will be an important factor at the high school level. (Rose & Betts, 2001) However, given the difficulty in overcoming demographic and socioeconomic limitations and the small number of high school counselors at each high school, improving access and enrollment may prove difficult if administrators and faculty see this exclusively as a counselor's role. Strong leadership at both the secondary and postsecondary level may be needed to help high school educators share in college graduation expectations. Many are already working hard just to help students earn their high school diploma.

Even with strong statistical analysis, data-driven policy changes may meet with significant resistance to historical roles in education. Faculty, administrators, and especially

elected officials, may need to battle the long-held notion that final results are the "responsibility" of either high schools or colleges. Providing the best opportunity for all students to succeed may be the duty of educators, but being held accountable for students' individual choices is another matter altogether. Whether they choose to go to college and if/how they prepare for it is ultimately a personal decision for each student.

Chapter 5

Summary, Conclusions and Recommendations

This study replicates the findings of other research studies. The rigor of high school mathematics courses does predict college graduation rates and the rate at which they complete their degree. The findings imply that policies and strategies can be employed at the high school level to positively impact college completion rates.

Recommendations

Provide increased formal and informal academic advising in high school.

It is essential for high schools and colleges to increase communication with secondary students and their parents regarding college-level mathematics requirements. The high school counselor is the most obvious person to help students make informed choices about courses with important consequences, but the small number of counselors available at area high schools requires that other administrators and instructors also play an active role in academic advising. Encouraging students to move into high levels of mathematics will go a long way in improving college graduation rates.

Anecdotally, I've learned that some high schools strongly encourage technical training after high school as opposed to traditional academic studies. Although this is an appropriate strategy for many students, high school personnel should be careful not to categorize students in the "not college material" group early in their high school career. Providing access and encouragement to pursue difficult classes should happen as they enter secondary education to allow enough time for completing higher levels of mathematics. This is especially true of less advantaged students.

> Given that certain subgroups are more likely to follow a more intensive math curriculum in high school**,** school counselors can play a critical role in diminishing the achievement gap that exists among racial groups by being more proactive in intensifying a student's curriculum, especially in math. Because prior academic achievement diminishes some of these differences, it is also imperative that school counselors encourage and support even lower-achieving students to complete more intensive courses especially if they plan to attend and succeed in a 4-year college. The high school counselor is in a unique position to help students make informed choices about courses with important consequences for their postsecondary lives. (Sciarra, 2010, p. 196)

Improve communication with the media and elected decision-makers.

Elected decision-makers must understand that improving college education rates in public colleges will require additional resources for public high schools. The media can play an important role of communicating research findings and potential policy issues to the public and policymakers.

Policymakers need to monitor the package of school resources that appears to be necessary to provide all students with equal opportunity to take some of the more-advanced math classes in high school. This package includes not only overall spending but also strategies aimed at providing an appropriate foundation for students to succeed in these more-advanced math courses. (Rose and Betts, 2001, p. 82).

By allocating school resources in ways that improve curriculum options, policymakers can better equip students with the skills to be successful in college upon graduation high school.

Amend current CSU admission requirements.

Regular admission to the CSU requires 1) a high school diploma or GED certificate, 2) completion of college preparatory courses (known as the A-G requirements) with a C or better, and a qualifying eligibility index. (CSUB, 2009) However, according to Adelman (1999), both test scores and (especially) high school grade point average are weak contributors to college degree attainment. He found that admission formulas emphasizing test scores and GPA are likely to result in lower college completion rates.

Relying on the A-G requirement of three mathematics courses (Algebra 1, Geometry, and Algebra 2) and students' GPA and test scores need to be reexamined in light of recent finding in curriculum rigor. Adelman (1999), Rose and Betts (2001), and others have reported for years that Algebra 2 must be considered a threshold course rather than the endpoint of a college preparatory program in mathematics.

Therefore the CSU system should consider requiring an additional mathematics course above Algebra 2 for regular admission. Additionally, students not meeting the regular admissions requirements should be a limited population given that their odds of college success are reduced. These students should be referred to community colleges to fulfill the necessary units to transfer under a regular admission basis.

Tinto (2004) voiced concern that using graduation rates for accountability purposes may cause institutions to purposefully reduce the number of low-income or otherwise disadvantaged students who are admitted as an attempt to improve completion rates. The purpose of this recommendation is not to restrict access to students who are prepared for college. It is a call to reprioritize admissions and enrollments as prescribed by policies already in place within the CSU

(CSU, 2001) and acknowledge that previously accepted levels of preparation (i.e. completing Algebra 2) are no longer useful for students. (Gates, n.d.)

Align high school Algebra 2 curriculum with college-level expectations.

As noted previously by Adelman (1999), Algebra 2 is no longer the gateway course to college mathematics. Perhaps by partnering together, faculty from both secondary and postsecondary institutions can align Algebra 2 courses more closely with the skills expected at beginning college students. Armstrong and Yecke (2006) have recommended expanding "faculty-faculty dialogue on curriculum alignment and competencies needed for postsecondary success" (p.22). The Gates Foundation (n.d.) reiterates this call to action: 'States and districts should align the content of high school standards to the syllabus for a course, the assessments connected to the course, and the teacher's instructional materials and guides" (p. 8)

Alternatively, postsecondary institutions could provide supplementary summer mathematics courses not only for those students needing remediation, but also for students completing Algebra 2 in high school. A refresher course will go a long way in helping students succeed in elementary statistics or finite mathematics, as required by the CSU general education program.

Study Limitations

The ability to generalize the findings of this study to other universities is somewhat limited because the conclusions must be interpreted within the context of higher education in the County of Kern. Also, this study does not address the effect of public policies requiring all students to complete certain mathematics courses. Such policies could have the unintended effect of contributing to a decrease in high school completion rates and should be considered carefully in small-scale projects before wider implementation. (Rose & Betts, 2001)

In this era of accountability, colleges and universities are expected to demonstrate success as measured by graduation rates. Yet, education and public policy literature suggests many complex components make up these rates. By using this predictive model of graduation rates and considering the accompanying policy recommendations, CSU Bakersfield can help inform stakeholders, expand partnerships that focus on college completion, and successfully enhance intervention programs already in place for students at risk of not graduating with a four-year degree.

Appendix

Table 9. Demographic and socioeconomic summary of Kern High School District students matriculating at CSUB in Fall 2005 and completing a bachelor's degree from any college

Gender	Completed Degree Within Four Years	Completed Degree Within Five Years	Completed Degree Within Six Years
Female (n=302)	28.8	45.4	50.0
Male (n=151)	14.6	35.1	42.4
Minority Status*			
Not an Under-Represented Minority (n=164)	29.3	45.7	51.2
Under-Represented Minority (n=239)	21.3	41.0	46.4
NSLP Participation in High School** (low income proxy)			
Did not participate in NSLP (n=280)	28.6	46.4	53.2
Participated in NSLP (n=173)	16.8	34.7	38.2
First Generation Status***			
At least one parent attended college (n=299)	23.7	42.8	48.8
No parent attended college (n=154)	24.7	40.3	44.8
Ethnicity			
African American or Black (n=34)	14.7	32.4	38.2
American Indian (n<5) ****	-	-	-
Asian or Pacific Islander (n=21)	14.3	38.1	42.9
Caucasian or White (n=143)	31.5	46.9	52.4
Hispanic or Latino (n=202)	21.8	42.1	47.5

** Underrepresented minority (URM) students have identified themselves as Black or African American, Hispanic or Latino, or Native American. All other students are considered non-URM.*

*** NSLP is the federal National School Lunch Program for families considered low income. This variable is used as a proxy for family income level.*

**** For the purposes of this study, "First Generation College Student" is defined as a college freshmen who has no parent that attended college*

***** The low numbers of American Indian students would have made it potentially possible to identify individual students during the analysis.*

Table 10. Academic summary of Kern High School District students matriculating at CSUB in Fall 2005 and completing a bachelor's degree from any college

Most Intensive Math Passed in High School	Completed Degree Within Four Years	Completed Degree Within Five Years	Completed Degree Within Six Years
Calculus (n=63)	28.6	49.2	57.1
Math Analysis (n=201)	29.4	49.3	53.2
Statistics (n=47)	29.8	40.4	44.7
Algebra 2 (n=114)	12.3	30.7	36.8
Less Than Algebra 2 (n=20)	15.0	25.0	30.0
Most Intensive Math Passed in High School			
Greater than Algebra 2 (n=311)	29.3	47.9	52.7
Algebra 2 or less (n=134)	12.7	29.9	35.8
Any Math Passed in Senior Year			
Any Math in Senior Year (n=358)	24.9	44.1	50.0
No Math in Senior Year (n=95)	21.1	33.7	37.9
Math Test Scores (SAT/ACT)			
At or above 75th percentile (n=119)	36.1	49.6	54.6
Below 75th percentile (n=271)	19.9	39.5	45.0
Did not take standardized test (n=63)	19.0	38.1	44.4
Math Remediation			
Math Remediation Not Needed (n=227)	32.2	52.4	58.6
Math Remediation Needed (n=226)	15.9	31.4	36.3
A-G Completion Status			
A-G Completed (n= 347)	28.2	47.8	53.0
A-G Not Completed (n= 106)	10.4	22.6	29.2

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Institutional Review Board for Human Subjects Research

Date: 18 February 2010

To: Laura Hecht, Assistant V-P
Institutional Research, Planning, & Assessment

cc: Paul Newberry, IRB Chair

From: Steve Suter, University Research Ethics Review Coordinator

Subject: **Approval of "Waiver of Authorization" for Protocol 10-30**

I am pleased to inform you that your protocol, **"CSUB/KHSD English and Math Remediation Project,"** has been approved by the IRB/HSR. The Board has determined that your request for waiver of research participants' authorization for use/disclosure of information about them for research purposes satisfies the necessary three criteria:

I. The use or disclosure of the information involves no more than a minimal risk to the privacy of individuals, based on presence of the following required elements.

   A. An adequate plan to protect the identifiers from improper use and disclosure. [Data provided to the investigator will contain no personal identifiers].
   B. An adequate plan to destroy the identifiers. [see above]
   C. Adequate written assurances that the information will not be reused or disclosed to any other person or entity, except as required by law, for authorized oversight of the research project, or for other research for which the use or disclosure of protected health information would be permitted by this subpart.

II. The research could not practicably be conducted without access to and use of the protected information.

IIII. The research could not practicably be conducted without the waiver.

Information To Be Accessed: For KHSD -- GPA, SAT, English/Math taken, high school attended. For CSUB – EPT and ELM scores, gender, date of birth.

The following person[s] only are authorized to interact with subjects or data having identifiers:

Human Subjects Protection Training Certified:

Laura Hecht [2-14-03] & Cheryl Holsonbake [5-02-08]

This authorization will be valid until the end of January, 2011. If more time is needed, you must request an extension from the Board. If you have any questions, or there are *any changes to your protocol*, *unanticipated problems*, or *adverse reactions*, please contact me immediately. Thank you.

Steve Suter, University Research Ethics Review Coordinator

CSU Bakersfield

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Institutional Review Board for Human Subjects Research

DATE: 10 May 2011

To: Laura Hecht, Assistant V-P
Institutional Research, Planning, & Assessment

cc: Paul Newberry, IRB Chair

From: Steve Suter, University Research Ethics Review Coordinator

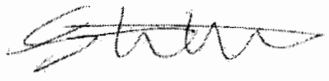
Subject: **Renewal of Authorization for Protocol 10-30**

I am pleased to inform you that your request for renewal of your Protocol 10-30, **"CSUB/KHSD English and Math Remediation Project"**, has been approved. I note that you indicate in your e-mail request of 5-10-11 that there are no proposed changes to your protocol.

This renewal will be valid until the end of January 2012. If more time is needed, you must request an extension from the Board. If you have any questions, *or there are any changes to your protocol*, please notify me immediately.

If any other personnel are added, who would be involved in data collection or obtaining informed consent, or who would have access to data containing personal identifiers, the IRB must be notified in advance. These persons must be HSPT-certified.

Signed consent documents must be retained for at least three years to enable research compliance monitoring and in case of concerns by research participants. Consent forms may be stored longer at the discretion of the principal investigator [PI].The PI is responsible for retaining consent forms. If the PI is a student, the faculty supervisor is responsible for the consent forms. The consent forms must be stored so that only the authorized investigators or representatives of the IRB have access. At the end of the retention period the consent forms must be destroyed [not re-cycled or thrown away].



Steve Suter, University Research Ethics Review Coordinator

References

Adelman, C. (1999). *Answers in the toolbox: Academic intensity, attendance patterns, and bachelor's degree attainment.* U.S. Department of Education, Office of Educational Research and Improvement. Washington, DC: U.S. Government Printing Office.

Adelman, C. (2004). *Answers in the toolbox.* U.S. Department of Education, Washington, DC: U.S. Government Printing Office.

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college.* U.S. Department of Education, Washington, DC: U.S. Government Printing Office. Retrieved on April 10, 2012 from http://www2.ed.gov/rschstat/research/pubs/toolboxrevisit/toolbox.pdf

Adelman, C. (2008). *The toolbox revisited: It's all about academic momentum* [PowerPoint slides]. Retrieved on May 14, 2012 from http://www.mnp20.org/reports/documents/MINNREVISIT1_000.ppt

Adelman, C., Daniel, B., Berkovits, I., & Owings, J. (2003). *Postsecondary attainment, attendance, curriculum, and performance: Selected results from the NELS:88/2000 postsecondary education transcript study (PETS)* (NCES Publication No. 2003-394). Washington, DC: U.S. Department of Education, Institute of Education Sciences.

Alon, S., & Tienda, M. (2005). Assessing the "mismatch" hypothesis: Differences in college graduation rates by institutional selectivity. *Sociology of Education, 78*(4), 294.

Armstrong, J. D. and Yecke, C. P. (2006). Closing the gap between high school graduation and college readiness. [PowerPoint slides.] Presentation to Florida Department of Education on April 18, 2006. Retrieved on April 9, 2012 from http://www.fldoe.org/board/meetings/2006_04_18/ClosingGap_Pres.pdf

Astin, A.W. (2005). Making Sense Out of Degree Completion Rates. *Journal of College Student Retention,* 7(1-2), 5-17.

Astin, A.W. (2003, September 22). College retention rates are often misleading. *Journal of Higher Education,* p. A48.

Bailey, B. L. (2006). Let the data talk: Developing models to explain IPEDS graduation rates. *New Directions for Institutional Research*, *2006*(131), 101-115.

Cragg, K. M. (2009). Influencing the probability for graduation at four-year institutions: A multi-model analysis. *Research in Higher Education*, 50(4), 394-413.

California State University. (2012). Budget facts: 2011-12 state funding reduction. Retrieved on June 6, 2012 from http://www.calstate.edu/pa/BudgetCentral/BFactSheet.pdf

California State University Bakersfield. (2007). *CSUB first-time freshmen profile: Fall 2007.* Retrieved on June 2, 2012, from http://www.csub.edu/irpa/FirstFreshFall2007.pdf

California State University Bakersfield. (2009). *2009-2011 Catalog.* California State University Bakersfield, Admissions and Records Department.

California State University Sacramento. (2001). CSU enrollment management memorandum. Retrieved on June 1, 2012, from http://www.csus.edu/acse/Scheduling/enrollment_ management_memo.pdf

DesJardins, S. L., & McCall, B. P. (2010). Simulating the effects of financial aid packages on college student stopout, reenrollment spells, and graduation chances. *Review of Higher Education*, *33*(4), 513-541.

Engstrom, C., & Tinto, V. (2008). Access without support is not opportunity. *Change: The Magazine of Higher Learning*, *40*(1), 46-50.

Ganderton, P. T., & Santos, R. (1995). Hispanic college attendance and completion: Evidence from the "High School and Beyond" surveys. *Economics of Education Review, 14*(1), 35-46.

Gates Foundation. (n/d). *Fewer, clearer, higher: Moving forward with consistent, rigorous standards for all students.* Retrieved on May 23, 2012, from http://www.gatesfoundation.org/highschools/Documents/fewer-clearer-higher-standards.pdf

Goenner, C. F., & Snaith, S. M. (2004). Accounting for model uncertainty in the prediction of university graduation rates. *Research in Higher Education*, *45*(1), 25-41.

Hinton, M. (2010). In need of a newer model. *Diverse: Issues In Higher Education*, *27*(18), 43.

Horn, L.; Kojaku, L.K.; Carroll, C.D. (2001). *High school academic curriculum and the persistence path through college: Persistence and transfer behavior of undergraduates 3 years after entering 4-year institutions.* Washington, DC: U.S. Department of Education. Retrieved on March 21, 2012, from http://nces.ed.gov/pubs2001/2001163.pdf

Institute for the Study of Knowledge Management in Education. (2012). *Assessing and externally validating graduation proficiencies: A study to explore lessons from the field.* Retrieved on May 12, 2012 from http://www.wascsenior.org/files/ISKME%20Paper%20on%20External%20Learning%20Assessment%20Feb%202012.pdf

Ishitani, T. T. (2005). Studying educational attainment among first-generation students in the United States. *Online Submission.* Paper presented at the Annual Forum of the Association for Institutional Research.

Kirst, M., & Venezia, A. (2001). Bridging the great divide between secondary schools and postsecondary education. *Phi Delta Kappan*, 83(1), 92-97.

Kirst, M. W., & Venezia, A. (2006). What states must do. *Chronicle of Higher Education*, B36-B37.

Koker, M., & Hendel, D. D. (2003). Predicting graduation rates for three groups of new advanced-standing cohorts. *Community College Journal of Research & Practice, 27*(2), 131.

Korey, J.L. (2011, August 8). *Introduction to Research Methods in Political Science: The POWERMUTT Project.* [Website.] Retrieved on June 7, 2012 from http://www.csupomona.edu/~jlkorey/POWERMUTT/Topics/contingency_tables.html

Liang, Z. (2009). Does state funding affect graduation rates at public four-year colleges and universities?. *Educational Policy, 23*(5), 714-731.

Lumina Foundation. (2012). *A stronger nation through higher education*. Retrieved on June 1, 2012 from http://www.luminafoundation.org/publications/A_Stronger_Nation-2012.pdf

Martinez, M, & Klopott, S. (2005). *The link between high school reform and college access and success for low-income and minority youth.* Retrieved on June 1, 2012, from http://www.aypf.org/publications/HSReformCollegeAccessandSuccess.pdf

Mortenson, T. G. & Wu, Z. (1990). *High school graduation and college participation of young adults by family income backgrounds: 1970 to 1989.* Student Financial Aid Research Report No. 90-3. American College Testing.

National Center for Education Statistics. (2003). *Postsecondary attainment attendance, curriculum, and performance: Selected results from the National Education Longitudinal Study of 1988* (NELS:88/2000).

National Center for Education Statistics. (2009). *Cumulative retention and attainment at first institution 6-year total 2009 by income percentile dependent students 2003-04.* QuickStats Table. Retrieved on March 5, 2012, from http://nces.ed.gov/datalab/quickstats/createtable.aspx

National Student Clearinghouse. (2012, June 2). Retrieved on June 2, 2012, from http://www.studentclearinghouse.org/colleges/studenttracker/

Nicholson, E. E. (1973). *Predictors of graduation from college*. American College Testing Program.

Planty, M., Hussar, W., Snyder, T., Provasnik, S., Kena, G., Dinkes, R., (2008). *The condition of education 2008* (NCES 2008-031). Washington, DC: U.S. Department of Education. Retrieved on June 1, 2012, from http://nces.ed.gov/pubs2008/2008031.pdf

Porter, S. R., & Umbach, P. D. (2006). College major choice: An analysis of person-environment fit. *Research In Higher Education, 47*(4), 429-449.

Post, T.R., Medhanie, A., Harwell, M., Norman, K.W., Dupuis, D.N., Muchlinski, T., Andersen, E., & Monson, D. (2010). The impact of prior mathematics achievement on the relationship between high school mathematics curricula and postsecondary mathematics performance, course-taking, and persistence. *Journal for Research in Mathematics Education,* 41(3), 274-308.

Powell, B. A., Gilleland, D., & Pearson, L. (2012). Expenditures, efficiency, and effectiveness in U.S. undergraduate higher education: A national benchmark model. *Journal of Higher Education*, 83(1), 102-127.

Rose, H. & Betts, J.R. (2001). *Math matters: The links between high school curriculum, college graduation, and earnings.* San Francisco, CA: The Public Policy Institute of California. [Electronic Version.] Retrieved from http://www.ppic.org/content/pubs/report/R_701JBR.pdf

Roth, J., Crans, G., & Carter, R. (2000). Effect of high school course-taking and grades on passing a college placement test. *The High School Journal,* 84(2), 72-87.

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

Selingo, J. (2012). The rise and fall of the graduation rate. *Chronicle of Higher Education*, *58*(27), A10-A12.

Tinto, V. (1973). College proximity and rates of college attendance. *American Educational Research Journal.* [Electronic Version.] *ERIC #ED074888*

Tinto, V. & Cullen, J. (1973). *Dropout in higher education: A review and theoretical synthesis of recent research*. [Electronic Version.] *ERIC #ED078802*.

Tinto, V. & Sherman, R. H. (1974). *The effectiveness of secondary and higher education intervention programs: A critical review of the research.* [Electronic Version.] *ERIC #ED101042*.

Tinto, V. (2004). *Student retention and graduation: Facing the truth, living with the consequences.* Occasional Paper. Pell Institute for the Study of Opportunity in Higher Education.

Tinto, V. (2008). *When access is not enough.* Carnegie Perspectives. Carnegie Foundation for the Advancement of Teaching.

Trusty, J., & Niles, S. G. (2003). High-School math courses and completion of the bachelor's degree. *Professional School Counseling,* 7(2), 99-107.

University of California. (2012). Admissions questions & answers on A-G. [Website] Retrieved on June 4, 2012 from http://www.universityofcalifornia.edu/admissions/counselors/q-and-a/subject/index.html#8

University of California (2012a). Doorways. [Website.] Retrieved on June 10, 2012, from http://www.ucop.edu/doorways/

U.S. Bureau of Labor Statistics. (2012). *Unemployment rates by metropolitan areas*. Retrieved on June 1, 2012 from http://www.bls.gov/web/metro/laummtrk.htm

U.S. Census Bureau. (2002). *The big payoff: Educational attainment and synthetic estimates of work-life earnings.* Retrieved on May 14, 2012, from http://www.census.gov/prod/2002pubs/p23-210.pdf

U.S. Department of Education. (2011). *College Completion Tool Kit.* Washington, D.C. Retrieved on May 30, 2012, from http://www.ed.gov/sites/default/files/cc-toolkit.pdf

U.S. Department of Education. (2011a). *Meeting the nation's 2020 goal: State targets for increasing the number and percentage of college graduates with degrees.* Companion document to the College Completion Tool Kit. Washington, D.C. Retrieved on May 30, 2012 from http://www2.ed.gov/policy/highered/guid/secletter/110323insert.pdf

USA Today. 2009. *Too many colleges fail to graduate students.* Editorial. Section 8A.

Warburton, E.C.; Bugarin, R.; and Nunez, A. (2001) *Bridging the gap: Academic preparation and postsecondary success of first-generation students.* U.S. Department of Education, National Center for Education Statistics. NCES 2001-153.