Dual Goals: The Academic Achievement of College Prep Students with Career Majors

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ABSTRACT

This study examines the feasibility of preparing students for both college and careers by analyzing data from a school reform model in which students are encouraged to take rigorous college preparatory courses while also focusing on career concentrations. This study draws upon data from that program, High Schools that Work, to explore the degree to which such "dual enrollers" are able to also attain academic results that are similar to the results of students who focus exclusively on preparing for college. Findings suggest that, collectively, "dual enrollers" achieve lower 12th-grade test scores than their college prep peers. However, these overall results mask the fact that dual enrollers in certain career concentrations actually outperform or equal those who focus exclusively on preparing for college.

Introduction

In recent years, "college and career-ready" has become a catchphrase in education policy circles. Since the 1990s, multiple waves of federal reforms have sought to provide Career and Technical Education (CTE) to all students (Stone and Aliaga, 2005). The Common Core State Standards crafted by the National Governor's Association and the Council of Chief State School Officers emphasize "college and career readiness" (National Governor's Association and Council of Chief State School Officers, 2010, p. 1). The Obama administration's blueprint for reauthorizing the Elementary and Secondary Education Act proposes that states implement standards and assessments that measure students' progress toward readiness for college and careers (US Department of Education, 2011). "We need to make sure we're graduating students who are ready for college and a career," U.S. President Barack Obama said in March 2011. "In the 21st century, it's not enough to leave no child behind. We need to help every child get ahead. We need to get every child on a path to academic excellence." (Jackson, 2011).

This emphasis on college and career readiness was fueled by findings that similar levels of student achievement are required for college and workforce readiness (ACT, 2006). It represents a sea change in a country that has traditionally provided high school students with preparation for college or careers (or neither).

It has traditionally been difficult to explore these questions because high schools have not necessarily emphasized dual preparation for college and for specific careers. Despite the rhetoric and reforms calling for universal career and college preparation, most American secondary

schools remain stratified into ability groups or tracks. Rare today are the overt and formal systems that once placed students into either college or career-preparation paths (Lucas, 1999). Yet the current flexible, choice-based tracking systems still tend to produce students who either fulfill the course requirements for colleges or focus on preparing for a career. (Lucas, 1999; Oakes, 2005). A third group emerges from high school without training for a specific career or completing the courses they need to enter college without remediation (Hallinan, 1994; Oakes, Selvin, Karoly, & Guiton, 1992; Stone & Aliaga, 2005). Only recently have CTE and general school reform efforts led to the emergence of a fourth pathway in which students both fulfill college requirements and prepare for a career (Stone & Aliaga, 2005). "Dual preparation" is Stone and Aliaga's term for this fourth pathway. Based on estimates by Levesque, Wun and Green (2011) fewer than 4% of America's 2.7 million 2005 high school graduates (or 102,060 students) dual enrolled by taking at least four credits in a single CTE concentration while also following a college preparatory curriculum consisting of at least four years of coursework in English, three in math, two in science, two in social studies and two in foreign language (Levesque, et al. 2011; Shettle, et al. , 2007). That's up from 2% in 1990 (Levesque et al., 2011). It is likely that the percentage of dual enrollers will continue to escalate because academic requirements have increased for all high school students, including students with CTE concentrations (Aliaga, Kotamraju & Stone, 2012).

Dual preparation is the focus of this research study. *High Schools That Work* (*HSTW*) is one of the most established models of dual preparation. An initiative of the Southern Regional Education Board, *HSTW* was started in 1987. The program now boasts more than 1,200 sites in 30 states. Its goal is to prepare every student for college, a career or both by providing rigorous academic coursework and high-quality training in a specific CTE concentration area. The program's recommended curriculum calls for at least four years of rigorous mathematics and English courses and three years of science courses. In addition, career-technical students are advised to take at least four courses in a single CTE concentration such as business or agriculture.

HSTW data is well-suited to exploring the feasibility of universal college and career preparation because the schools that adapt the program contain relatively high numbers of dual enrollers. (Nearly 12% of the *HSTW* students in the class of 2008 dual enrolled.) However, not all students in *HSTW* schools choose to follow the program's recommended dual enrollment path. This means that a comparison group is available of students who focus exclusively on college preparation, CTE students who do not prepare for college, and students who prepared neither for college nor careers. This research study focused on comparing dual enrollers to these three other groups. A finer grained set of comparisons examined the relative achievement levels and dual enrollment rates of students preparing for different types of careers (e.g. finance versus hospitality and tourism).

For the purposes of clarity, the following terms will be used throughout this paper. Students will be referred to as "college prep" if they take at least four years of college-prep English, four years of math at the algebra level or higher and three years of college-prep, laboratory-based science. Students will be referred to as CTE if they take at least four courses in a single CTE concentration. (The rationales for these definitions are explained in the Methodology section of this paper.) Students will be referred to as "dual enrollers" if they meet

both the college-prep and the CTE criteria. The remaining students in this study met neither the criteria for college prep nor CTE. They will be referred to as "general" track students.

Conceptual Framework

Since the early nineteenth century, American high schools have used "tracking" to sort students according to their perceived ability levels (Oakes, 2005). Classic conceptions of tracking relied upon explicit efforts to funnel higher-performing students into clearly-defined college prep tracks and lower-performing students into clearly-defined vocational tracks. (Often, these tracks coincided with ethnicity and socio-economic status.) In the sixties and seventies, many schools made strides toward dismantling this style of simplistic, top-down overt grouping (Lucas, 1999). Students are generally now permitted to combine CTE and college prep coursework, resulting in a situation in which nearly everyone is involved in some way in CTE (Aliaga, Kotamraju & Stone, 2012). Additionally, the recent college-for-all movement has led to overall increases in academic coursework requirements. Given these developments, Aliaga et al. (2012) argue that it is no longer relevant for researchers to classify students dichotomously as CTE versus academically focused. Further, they suggest that heavy CTE course loads are no longer signals that a student has been relegated to the lower tracks due to special needs or poor academic performance. The very existence of the dual enrollment category would appear to provide some support for these views.

Yet tracking scholars contend that tracking survived the dismantlement of the old vocational/college prep dichotomy (Oakes, 2005). In a movement Lucas describes as the "unremarked revolution" tracking in the sixties and seventies became less overt and more complex (Lucas, 1999, p. 131). Like the old system, the new one still provides different paths for higher and lower-performing students. Yet because tracking is no longer out in the open or imposed from above, many students are unaware that their seemingly low-stake course selections are actually pathways to very different places. For instance, students who choose CTE classes rather than foreign language electives may not realize that they are making themselves ineligible for admissions to many four-year colleges.

This study proceeds from the theories and research of Lucas and others that the practice of tracking may have changed but it has not withered away. As such, we aim to examine where dual enrollment fits into the longstanding tradition of creating distinct paths for students perceived to be of lower and higher ability. One possibility is that dual enrollment is a means of *de*tracking, a pathway that permits students to prepare for careers while truly experiencing the same level of academic rigor previously preserved for those in the higher tracks. If this were the case, one might expect the achievement of dual enrollers to match the achievement of college prep students who are not enrolled in CTE. Another possibility is that dual enrollment is yet another iteration of a track. Perhaps it is a rung below or a step above the college preparatory track. Further, it is also possible that ability groups or "tracks" exist within CTE's many concentrations. Is a student who concentrates on truck driving as likely to complete her college prep coursework as is a student who concentrates on engineering? If so, how does her performance compare to that of her college prep peers? By exploring questions like these, we hope to gain a better understanding of dual enrollment's location vis-à-vis the tracking structure.

Literature Review

Background: CTE Versus non-CTE Students

Of the 2.7 million students who graduated from American high schools in 2005, 92% took at least one CTE course and 21% completed a CTE concentration of at least four courses in a single occupational area (Levesque et al., 2008; Shettle et. al, 2007). These CTE concentrators have historically underperformed their peers on measures of academic achievement. However, researchers have traditionally found that much of the gap is associated with CTE students arriving in high school less prepared than their peers then proceeding to take less rigorous academic coursework (Bae, Gray & Yaeger, 2007; Levesque et al., 2008). CTE students also have lower educational aspirations than their non-CTE peers and are more likely to come from low-income families (Agodini, Uhl & Novak, 2004). This suggests that CTE, indeed remains a lower rung of a tracked system.

However, the achievement gap between CTE and non-CTE students has narrowed in the past 20 years as legislation such as the 2006 Perkins Act has encouraged CTE students to take more rigorous academic coursework. (Levesque et al., 2011; Levesque et al., 2008). In essence, overall CTE achievement has increased and the CTE/non-CTE gap has narrowed as greater numbers of CTE students have become dual enrollers. Studies that control for student characteristics such as high school preparation levels suggest that CTE coursework has a neutral effect on academic achievement (Levesque et al., 2011).

However, most studies that compared CTE and non-CTE participants do so without sorting out dual enrollers from CTE students or distinguishing between college-prep and general track students. Three exceptions are studies by Stone and Aliaga (2005), Plank (2001) and Levesque et al. (2000). Stone and Aliaga (2005) analyzed the 1997 National Longitudinal Survey of Youth. After controlling for student characteristics (gender, race, parent education, school location and 8th-grade GPA), they found that the GPAs of dual concentrators were lower than the GPAs of their college preparatory peers but higher than the GPAs of CTE or general track students. General track students had the lowest GPAs of all. In examining the 1988 National Education Longitudinal Study, Plank (2001) also found that dual concentrators lagged slightly behind college prep students (on student achievement tests) even after controlling for gender, race, socio-economic (SES) status and eighth-grade test scores. Unlike Stone and Aliaga (2005), he found that CTE students –not general track students--had the lowest scores of all. Finally, in their analysis of data from the National Education Longitudinal Study of 1988, Levesque et al. (2000) found no statistically significant differences between the mathematics, reading and science test score gains made between grades 8 and 12 by dual enrollers and college-prep students. Both dual enrollers and college prep students outperformed CTE and general track students. CTE and general track students made similar gains in reading while general track students made slightly greater gains in math and science. Levesque et al. (2000) also found that dual enrollers were also almost as likely as college prep students to be enrolled in college two years after graduation. Both groups were more likely to enroll in college than either CTE or general track students.

Student Achievement and Dual Enrollment within CTE Subspecialties

Research suggests that CTE students and dual enrollers differ not only from non-CTE students but from one another. Specifically, within the CTE/dual enrollment pathways, students in different career concentrations experience different rates of dual enrollment and different levels academic achievement.

Hudson and Hurst (1999) found that dual enrollment rates varied widely by CTE specialty, ranging from 3% for food service and hospitality to 43% for technology and communications. Levesque et al. (2011) found students in different concentrations had different science course-taking patterns and scores on the National Assessment of Education Progress (NAEP) 12th-grade science exam. (They defined students as CTE concentrators if they had taken at least two courses in a particular subject area.) The number of science courses ranged from 1.6 for construction and architecture students to 2.6 for computer and information science students. NAEP science scores ranged from 126 for culinary arts students to 155 in computer and information science on a scale of 0 to 300. Additionally, Levesque et al. (2008) found that the more CTE credits a student earns, the more likely he is to take a lower-level math course in grade 9. But this only holds for certain occupations (agriculture, mechanics and repair, materials production, construction, food service and hospitality, and personal service.) In the areas of computer technology and communications technology, students who earned more CTE credits were more likely to take harder mathematics classes in ninth grade.

Research Questions

Castellano, Stringfield and Stone (2003, p. 260) singled out *HSTW* as "an appealing design because it has shown success with vocational students, many of whom are at risk of dropping out of high school." They noted that participation in *HSTW* is associated with improved achievement, attendance, graduation, and postsecondary enrollment. However, they suggest that the limitations of past studies on *HSTW* signal the need for further research on the reform. More generally, they note that the intersection between CTE and academic reforms has been "seriously understudied." (Castellano et al, 2003, p. 263).

Because dual enrollment is a relatively recent phenomenon, it has also been under-studied to the point where it is not clear where it fits into the highly, if informally stratified or "tracked" structure of the American high school curriculum. Further, relatively little research has examined the interaction between dual enrollment and specific career concentrations within CTE. This study uses data from *HSTW* to help address these gaps in the research body. As such, the research questions are:

1. How does the achievement of dual enrollment students compare to the achievement of college prep, CTE and general track students on the *HSTW* grade 12 assessments of mathematics, reading and science?
2. How do CTE concentrations differ from one another in terms of dual enrollment rates and achievement on *HSTW* twelfth-grade assessments of mathematics, reading and science?
3. How do dual enrollment students in different concentrations compare to college-prep students on the *HSTW* assessments of mathematics, reading and science?

Methodology

Participants

The participants in this study were students in 1,032 programs and schools that have adopted the *HSTW* model of comprehensive school reform. Because *HSTW* is a collection of unifying philosophies and practices rather than a scripted, tightly-controlled reform, the program looks different at different schools. However, the program's overarching principle is that "most students can master rigorous academic and CT studies if school leaders and teachers create a culture of high expectations and continuous improvement that motivates students to make the effort to succeed" (Southern Regional Education Board, 2011, p. 2). The program has ten key practices which include integrating school and work-based learning, cross-disciplinary cooperation among teachers and providing a structured support system of extra help to improve the odds of student success in rigorous academic and technical courses (Southern Regional Education Board, 2011).

In 2008, the Southern Regional Education Board administered tests in mathematics, science and English to 67,080 students who were 12th-graders at 1,032 programs and schools that had chosen to employ the *High Schools that Work* model. These assessments are administered every two years to a sample of 12th-graders at each school. The assessments were created by the Educational Testing Service. Each 2008 exam was tied to NAEP standards. Like NAEP, the 2008 assessments employed both multiple choice and constructed response formats.

The tests were accompanied by a 317-question survey on each student's course-taking history, demographics and school-related attitudes and experiences. The Educational Testing Service created the surveys with input from the Southern Regional Education Board. The test-takers' teachers were instructed to obtain the test-takers transcripts and respond to 73 questions on the specific courses each student had taken in high school. The remaining 244 questions were answered by the test-taking students themselves. A total of 47,969 of the original 67,080 students were included in this research study because they 1) answered enough questions for tests to be scored in all three subjects and 2) returned surveys that included responses to a question that asked respondents to either identify one of 17 CTE concentrations in which they expected to take four or more credits by graduation or state that they were not CTE concentrators.

On the basis of the survey responses, students were divided into four categories: college prep, CTE, dual enrollment or general track. The categories are explained in the following paragraphs. Students were identified as "college prep" if they met the *HSTW* curriculum goals. This meant they took at least four college-preparatory English courses, with the content and performance standards that emphasize reading, writing and presentation skills. They took at least four mathematics courses, including algebra I, geometry, algebra II and a fourth higher-level mathematics course. Finally, they took at least three college-preparatory, lab-based science courses. A total of 13,023 students (27%) met the college prep criteria. Depending on the definition of college prep, national estimates of the percentage of college prep students in the class of 2005 ranged from 48% to 66% (Levesque et al., 2008). However, both of the "college prep" definitions used in Levesque et al. were less stringent than the *HSTW* definitions in that they required less math.

In analyses that used National Center for Education Statistics databases to compare CTE with non-CTE students, both Levesque et al. (2008) and Levesque et al. (2000) classified students as CTE if they have taken at least four CTE credits (Carnegie Units.) Our research study also identified students as CTE if their survey responses indicated that they had taken four or more credits or Carnegie units. However, in line with the *HSTW* conception of CTE, we only counted students as CTE if they had taken all four credits in the same concentration area.

The 2008 *HSTW* survey provided a list of 17 CTE concentration areas. (For a description of the 17 CTE concentration areas as they appeared on the survey, see Appendix A.) Of these 17 CTE concentration areas, the most commonly-selected options were health science (n=3,747), business management (n= 3,757) and arts/ technology (n= 3,243). (See Table 1.) Nationwide, CTE concentrators are most likely to specialize in computer technology and agriculture (Levesque et al., 2008). Levesque et al., however, defined CTE concentrators as those who took three or more credits in a concentration while we defined them as taking four or more classes in a concentration. They also used slightly different categories of CTE concentrations.

Table 1.
Numbers and Percentages of HSTW Students by CTE Concentration

CTE Concentration	Number	Percent of CTE Students
Agriculture	2434	8
Architecture/Construction	2411	8
Arts Technology	3243	11
Business Management	3757	12
Education	533	2
Finance	252	1
Government	159	1
Health Science	3747	12
Hospitality	915	3
Human Services	2501	8
Info Tech	1864	6
Law/Safety	741	2
Manufacturing	937	3
Marketing	484	2
Science	2236	7
Transportation	1212	4
Other	3103	10
Total CTE	**30529**	**100**

A total of 30,529 *HSTW* students surveyed (64%) took at least four CTE courses in a single concentration area. Depending upon how CTE concentration is defined, national

estimates of the percentage of CTE concentrators range from 4% to 25% (Stone & Aliaga, 2005). Given the CTE focus of *HSTW,* it is not surprising that CTE concentrators are over-represented in this research study sample.

Students who met the criteria for CTE and college prep were defined as dual enrollers. A total of 7,271 students or 15% dual enrolled. That left 5,752 college-prep students who were not dual enrollers (12%). Students who met the criteria neither for CTE nor for college prep were defined as general track. A total 11,688 or 24% were in the general track.

Three student-reported demographic variables were used as controls in this research study: SES, ethnicity and gender. Another set of self-reported responses were used as variables to control for students' level of preparation for college-prep high school courses in math, English and science. Finally, the *HSTW* assessments in mathematics, English and science were used as outcome variables measuring achievement levels. Descriptive statistics of all these variables suggested different profiles for college-prep students, CTE students, dual enrollers and general track students. The analysis also suggested different profiles for students in the 17 different CTE concentrations. In the following sections of this paper, these varying profiles are described.

Demographic and Academic Achievement Variables

Students' self-reports of SES, ethnicity and gender were the three demographic variables used in this research. Students were coded as "low-SES" if they indicated that neither parent had obtained any education beyond high school. Based upon this measure, 29,822 students (61%) were classified as low-SES. Like SES, ethnicity was a dummy variable with the two categories: "white" and "minority." Students were classified as minorities if they classified themselves as Asian, black, Hispanic, Native American, Pacific Islander, or multiracial. Students were classified as "white" if they classified themselves as "white." A total of 19,437 or 40% of students were minorities. Finally, 25,668 or 52% of students classified themselves as female.

A total of four variables were used to control for preparation levels in math, reading and science. Three of these variables were based on student responses to the following question: "When you entered high school, how prepared were you with the necessary knowledge and skills to succeed in college-preparatory courses in the following areas?" Four separate questions then asked students to respond to this query by rating their preparation levels in each subject (reading, writing, mathematics and science.) Based upon responses to these questions, dichotomous dummy variables were created. Students were rated as "well-prepared" if they responded that they were "very well prepared." (The other two options were "somewhat prepared" or "not at all prepared.") Students were rated as "well-prepared" in reading if they responded that they were "very well-prepared" in both reading and writing. A total of 20,323 students (42%) responded that they were well-prepared for college-prep English. A total of 20,830 (46%) responded that they were well-prepared for college-prep science.

In order to be rated "well-prepared" for college prep math, students had to both respond that they were "very well-prepared" for college prep math and also report that they had

completed algebra I in 6th, 7th or 8th grade. A total of 11,727 students (25%) were rated "well-prepared" in college-level math.

The outcome variables in this research study were the scale scores for the three 12th grade exams in English, math and science. All exams were scored on a scale of 0 to 500. In English, the mean score was 251 with a standard deviation of 39. In mathematics, the mean score was also 251 with a standard deviation of 39. In science, the mean score was 252 with a standard deviation of 39.

Dual enrollment, College-prep, CTE and General: Demographic and Academic Profiles

Descriptive statistics and post-hoc testing revealed significant differences in the demographic profiles, high school preparation levels and 12th grade achievement levels of students classified as college-prep, dual enrollment, CTE and general. (Table 2).

With the analysis of descriptive data, a profile emerged of the dual enrollment students in *High Schools that Work* schools. (See Table 1.) Demographically, dual enrollment students did not necessarily resemble the college prep peers to whom they were compared in this research study. They were more likely to be low-SES and minority and less likely to be female. Compared to college prep students, they exhibited similar, but slightly lower, high school preparation levels in English, math and science. Their 12th test scores lagged behind those of college prep students. However, both their achievement scores and preparation levels were more similar to college prep students' scores than to general or CTE students' scores.

Table 2.

Demographic Profile, High School Preparation Levels and 12th Grade Achievement Exam Results by Curriculum Concentration: Descriptive Statistics

		Curriculum Concentration			
Variable	All	C-prep	Dual	CTE	General
Demographics					
% low-SES	65	50*	56*	72*	65*
% minority	40	35*	41*	38*	45*
% female	53	59*	55[1]	49*	55[1]
H.S. Preparation					
%Well-prep English	44	56*	52*	39*	41*
%Well-prep math	25	43[*]	41[*]	18[2]	19[2]
%Well-prep science	46	58[*]	56[*]	41[3]	41[3]
12th grade Scale Scores					

English	251*	272*	265*	243*	248*
	(39)	(37)	(38)	(37)	(38)
Math	251*	271*	265*	244*	248*
	(39)	(37)	(38)	(37)	(38)
Science	252*	270*	263*	245*	248*
	(39)	(35)	(37)	(38)	(39)

Note. Standard deviations for scale scores are presented in parentheses.
[1]p>.05 general and dual enrollment.
[2]p> .05 CTE and general
[3]p> .05 for CTE and general
*p<.05

Dual Enrollers in Different Concentrations Compared to College Prep Students: Demographic and Academic Profiles

The 7,271 dual enrollers in this research study were neither demographically nor academically homogeneous. Rather, they differed significantly depending on which of the 17 CTE concentrations they experienced. (Table 1.) Science and arts technology has the highest SES levels, while manufacturing and transportation had the lowest. (Table 3.) Manufacturing and agriculture had the lowest percentage of minorities. Finance and business management had the highest. Manufacturing and transportation were predominantly male. Health science and human services were predominantly female. Thus, specific demographic profiles emerged for many concentrations. Manufacturing and transportation students, for example, were most likely to be low-SES white males.

Table 3
Dual Enrollers' CTE Concentrations: Percent Low-SES, Minority and Female and Total Number of Dual Enrollers per Concentration

CTE Concentration	%Low-SES	%Minority	%Female	Total *N*
Agriculture	59	28	53	512
Architecture/Construction	57	31	14	439
Arts Technology	46	35	65	1019
Business Management	60	52	55	1058
Education	61	33	78	153
Finance	54	64	67	65
Government	46	47	41	46
Health Science	59	48	83	1100
Hospitality	64	52	70	147
Human Services	68	44	92	415
Info Tech	54	45	31	386
Law/Safety	64	56	54	108
Manufacturing	62	30	11	73
Marketing	56	50	58	108

Science	46	30	31	1007
Transportation	67	26	8	96
Other	59	47	50	539
Total Dual	56	41	55	7271
Total College Prep	50	35	50	5752

Dual enrollers in different concentrations also arrived in high school with different levels of preparation for college-prep work. (Table 4.) Government students had the highest preparation levels in English. Manufacturing and transportation students were least prepared in English. Manufacturing and human services were the least prepared in science and in math. Science students had the highest levels of preparation in both science and in math. College-prep students were better-prepared than any of the 17 sub-groups of dual-enrolled CTE concentrators.

Table 4

Percentage of Dual Enrollers Who Were "Very Well-prepared" For College-prep work in English, Math and Science, by CTE concentration

CTE Concentration	English	Math	Science
Agriculture	38	20	45
Architecture/Construction	32	22	43
Arts Technology	50	26	46
Business Management	45	25	44
Education	49	21	41
Finance	47	30	42
Government	52	27	45
Health Science	47	23	47
Hospitality	41	20	39
Human Services	44	17	36
Info Tech	45	26	51
Law/Safety	46	20	47
Manufacturing	27	17	38
Marketing	48	21	43
Science	45	42	59
Transportation	29	19	37
Other	39	20	42
Total Dual Enrolled	40	23	42
Total College Prep	56	43	58

Post hoc testing of grade 12 English, math and science achievement scores suggested significant differences among concentrations, with the scores of some dual enrolled concentrations statistically indistinguishable from the scores of college prep students. (Table 5.)

Students in one concentration (science) scored significantly higher (at a .05 level) than college prep students scored in science and math and higher (with $p<.05$) in English. Students in five concentrations earned scores in all three subjects that were statistically indistinguishable from the scores of college prep students. Dual enrollers in six additional concentrations earned scores in at least one subject that were statistically indistinguishable from the scores of college prep students. Compared to college prep students, dual enrollers in five of the 17 concentrations earned significantly lower scores ($p<.05$) in all three subjects.

Table 5

Dual Enrollers' Grade 12 English, math and science achievement scores by CTE concentration with Comparison to College Prep Students.

CTE Concentration	English	Math	Science
Agriculture	266	267	267
	(34)	(32)	(33)
Architecture/Construction	254*	266*	260*
	(40)	(37)	(40)
Arts Technology	274	270	260
	(39)	(35)	(36)
Business Management	255*	258*	254*
	(38)	(39)	(36)
Education	260	263	255*
	(41)	(35)	(36)
Finance	251*	262	251*
	(50)	(36)	(39)
Government	271	264	268
	(36)	(49)	(42)
Health Science	268	261*	263*
	(35)	(36)	(32)
Hospitality	253*	253*	246*
	(40)	(43)	(46)
Human Services	256*	250*	251*
	(36)	(37)	(34)
Info Tech	273	273	273
	(38)	(36)	(35)
Law/Safety	257*	258	254*
	(42)	(42)	(41)
Manufacturing	255*	256	255*
	(38)	(38)	(44)
Marketing	263	260	261
	(34)	(36)	(36)
Science	277	284*	279*
	(36)	(34)	(34)

Transportation	249*	263	262
	(40)	(32)	(33)
Other	258*	260*	258*
	(39)	(39)	(37)
Total Dual Enrolled	265*	265*	263*
	(38)	(38)	(37)
Total College Prep	272	271	270
	(37)	(37)	(35)

Note. Scales range from 0 to 500 on all three tests. Standard deviations are shown in parentheses. *= Significantly lower than college prep students' mean score at a .05 level.

Finally, we examined dual enrollment rates for CTE concentration areas. Here, once again, different concentrations exhibited different profiles. The concentrations with the lowest dual enrollment rates were manufacturing and transportation (9%). Science students had the highest level of dual enrollment (47%).

Table 6.

Percent of Dual-Enrolled Students in Each CTE concentration

CTE Concentration	Percent Dual Enrolled Students
Agriculture	22
Architecture/Construction	19
Arts Technology	33
Business Management	29
Education	30
Finance	29
Government	31
Health Science	30
Hospitality	17
Human Services	17
Info Tech	22
Law/Safety	16
Manufacturing	9
Marketing	24
Science	47
Transportation	9
Other	18
Total CTE	25

Procedures

The 12th grade achievement levels of dual enrollment, college prep, CTE and general track students were compared using three separate general linear regression models. Mathematics scale scores was the dependent variable for the first model. English scale scores was the dependent variable for the second model. Science scale scores was the dependent variable for the third model. We entered the independent variables in three different blocks. The first iteration of our models contained only the dependent variable (the test score) and the student's high school program. Block two contained the three demographic variables described above: SES, race and gender. For all three models, the third and final block contained the previously described variables related to the student's self-reported preparation levels for the relevant subject (English, math or science). After block 3, variables were removed if $p > .05$

A second set of models used linear regression to compare the English, math and science achievement of dual enrollers in each of the 17 CTE concentrations to college prep students. Again, there were three separate models, each with a different outcome variable: mathematics scale scores, English scale scores or science scale scores. The independent variables were entered in three blocks. The first block of each model contained a dummy variable that indicated whether each individual was a dual enroller or a college-prep student. The second block contained the three demographic variables of SES, race and gender. The third block contained self-reported preparation levels for the relevant subject. After block 3, variables were removed if $p > .05$.

Results

12th –Grade Achievement of Dual Enrollment Students Compared to College-prep, General Track and CTE Students

Results were consistent for multiple regression analyses comparing the achievement rates of dual enrollment students versus college prep, general track and CTE peers. In English, math and science, college prep students earned the highest scores, even after we controlled for demographics (SES, gender and minority status) and subject-specific preparation levels. (Table 7.) CTE students lagged behind college prep students, with the smallest difference in math and the biggest difference in English. Although small (4 to 5 points on a 500-point scale), the differences were statistically significant. Dual enrollers scored significantly higher than general track and CTE students, who consistently earned the lowest scores. Demographic and preparation controls were statistically significant in all three analyses. However, the models left much variability unexplained, with R^2 levels ranging from .16 in English to .19 in math. A similar analysis (Bae et al., 2007) of the math achievement of CTE and non-CTE students had an R^2 of .44. Our low R^2s are likely due to our imperfect measures of pre-high school achievement levels. Unlike Bae et al., we lacked pre-high school achievement test results and so instead relied upon self-reports of preparation levels.

Table 7
Multiple Regression Analysis for Variables Predicting 12th- grade English, Math and Science Achievement with Dual Enrollers as Reference Group

Variable	English B	Math B	Science B
Constant	268.14*	273.49*	272.73*
	(.55)	(.54)	(.56)
CT	-18.32*	-16.85*	-15.61*
	(.50)	(.49)	(.49)
General	-13.60*	-11.90*	-12.10*
	(.54)	(.53)	(.53)
College-prep	5.20*	3.75*	4.43*
	(.64)	(.63)	(.63)
Low-SES	-8.44*	-8.30*	-8.03*
	(.36)	(.35)	(.36)
Minority	-17.90*	-20.76*	-20.35*
	(.35)	(.34)	(.34)
Female	8.36*	-2.62*	-3.54*
	(.34)	(.33)	(.34)
Preparation level	8.73*	16.78*	10.91*
	(.35)	(.39)	(.34)
R^2	.16	.19	.17

Note. Standard errors are shown in parentheses. The reference category is "dual enrollment" The test score scales are 0 to 500.*p <.05.

12th–Grade Achievement of College Prep Compared to Dual Enrollment Students, by CTE Concentration

Even after controlling for demographics and preparation levels, dual enrollers in most concentrations lagged behind college prep students. (Table 8.) In fact, controlling for demographics and preparation levels made dual enrollers in six concentrations compare less favorably to college prep students in at least one subject in which their average scores were statistically indistinguishable from college prep students' scores. (Table 8, Table 5.) (Scores of dual enrollers in a seventh concentration, education, went from being statistically similar into English and math and worse in science to being the same in English and science and worse in math.) Four of these concentrations enrolled small numbers of dual concentrators: government (n= 46), law (n=108), manufacturing (n=73), transportation (n= 96). Noise resulting from these small sample sizes may be responsible for these results. It is less clear why dual enrollers in agriculture (n=512) and health (n= 1,100) compared more poorly to college prep peers after we controlled for demographic factors and preparation levels. In the case of the health concentration, one possibility is that the high percentage of females (83%) helped explain why average English scores were indistinguishable from the scores of college prep peers, yet lagged behind college prep students' scores after we controlled for demographics. On average, college prep and dual enrolled females scores 5 points higher than males on the English test.

Table 8

Multiple Regression Analyses for Variables Predicting 12th-Grade English, Math and Science Achievement for Dual Enrollers by Concentration, with College Prep Students as the Reference Category

Variable	English β	Math β	Science β
Constant	275.32*	278.35*	278.06*
	(.80)	(.73)	(.77)
Agriculture	-6.61*	-5.35*	-4.05*
	(1.65)	(1.52)	(1.52)
Architecture/Construction	-14.84*	-7.68*	-11.78*
	(1.78)	(1.65)	(1.65)
Arts Technology	1.21	-.27	-.84
	(1.20)	(1.12)	(1.12)
Business Management	-11.31*	-7.36*	-10.67*
	(1.19)	(1.11)	(1.10)
Education	-12.47*	-5.19	-12.35*
	(2.90)	(2.71)	(2.68)
Finance	-8.27	3.07	-4.01
	(4.42)	(4.09)	(4.1)
Government	-1.30	-11.09*	-3.01
	(5.22)	(4.86)	(4.81)
Health Science	-2.30*	-4.07*	-2.40*
	(1.12)	(1.09)	(1.10)
Hospitality	-15.10*	-9.87*	-17.27*
	(2.9)	(2.8)	(2.72)
Human Services	-14.64*	-14.27*	-13.38*
	(1.83)	(1.70)	(1.70)
Info Tech	6.67*	1.76	5.38*
	(1.88)	(1.7)	(1.74)
Law/Safety	-9.36*	-4.71	-9.23*
	(3.44)	(3.22)	(3.20)
Manufacturing	-18.10*	-17.13*	-14.37*
	(4.15)	(3.89)	(3.90)
Marketing	-4.24	-4.41	-3.98
	(3.42)	(3.20)	(3.16)
Science	4.69*	6.95*	5.58*
	(1.23)	(1.14)	(1.13)
Transportation	-20.88*	-11.33*	-11.43*
	(3.67)	(3.41)	(3.45)
Other	-10.19*	-7.57*	-7.92*
	(1.60)	(1.48)	(1.49)
Low-SES	-7.47*	-6.93*	-7.03*
	(.63)	(.59)	(.59)

Minority	-21.48*	-24.44*	-22.00*
	(.66)	(.61)	(.61)
Female	6.70*	-5.14*	-5.12*
	(.67)	(.62)	(.63)
Preparation Level	8.29*	19.10*	11.17*
	(.63)	(.60)	(.59)
R^2	.15	.24	.19

*=p<.05

Controlling for demographics and preparation levels did not alter the relationship between college prep students and dual enrollers in eight concentrations. Architecture, business, hospitality, human services and "other" dual enrollers still earned significantly lower scores than college prep students in all three subjects. Marketing dual enrollers continued to earn scores that were lower than the scores of their college prep peers, but not significantly. Arts/technology dual enrollers continued to outscore college prep students in English and lag behind them in science and math, but the differences, again, were not statistically significant.

Dual enrollers in three concentrations (science, information technology and finance) compared more favorably to college prep students after we controlled for demographics and preparation levels. Science students' average scores were higher than college prep students' scores in all three subjects but the differences were not statistically significant for English. After we controlled for demographics and preparation levels, they scored significantly higher in all three subjects. On average, information technology dual enrollers outscored college prep students in all three subjects, but the differences were not statistically significant. After we controlled for demographics and preparation levels, information technology dual enrollers scored significantly higher in English and science and higher in math.

There were no significant differences between the average English and science scores of college prep and finance dual enrollers. However, college prep students scored significantly higher, on average, in math. After we controlled for demographics and preparation levels, scores on all three tests did not differ significantly for dual enrolled finance students and their college prep peers.

As with the models that compared dual enrollers with college prep, general track and CTE students, much variation was left unexplained with the models that compared college prep students with dual enrollers in different concentrations. The R^2 s for the three models ranged from .15 for English to .24 for math. Again, we likely would have explained a greater percentage of the variability if we had been able to access a measure of past achievement that did not rely on students' self-reports of preparation levels.

Discussion

The results of this study provide evidence that dual enrollment both challenges the tracking system and fits within its purviews. As a group, dual enrollers did arrive in *High Schools that Work* schools with slightly lower self-reported preparation levels than their college prep peers, especially in English. They also faced slightly greater demographic challenges in

that they were more likely to belong to groups (low-income, minority) that have historically experienced lower academic achievement. As such, they fit the profile of lower track students. Further, even after we controlled for these lower preparation levels and also for demographics, dual enrollers' senior-year English, math and science scores remained lower than the scores of their college prep peers. CTE students who did not dual enroll also lagged behind their general track peers.

However, the differences between CTE and general track students were small. The differences between dual enrollers and CTE or general track students were much larger: In general, CTE students looked a lot like general track students while dual enrollers looked a lot like college prep students. The real achievement gap was between CTE and non-CTE students who took college prep courses and CTE and non-CTE students who did not. This suggests that dual enrollment is actually succeeding as a form of detracking. It is doing so by taking lower-performing students, and offering them an education that combines CTE with academic coursework that permits them to earn test scores that are nearly the same as the scores of college prep peers who were better prepared for high school coursework. These findings—that the academic achievement of dual enrollers closely resembles that of their college prep peers —are in line with the small body of research that compares the achievement levels of dual enrollers and non-dual enrollers with the achievement levels of college prep and general track students (Levesque, 2000; Plank, 2001; Stone & Aliaga, 2005).

Yet the story is not so simple. This study also confirms past research that indicated significant differences between career concentrations (Hudson & Hurst, 1999; Levesque et al., 2011). These results suggest that CTE concentrations are, unto themselves, very different and separate tracks. Further, it appears that the coursework variations associated with different concentrations may further compound the differences between concentrations. College prep students entered high school with higher preparation levels than dual enrollers in any one of the 17 career concentrations, with the exception of science students, who were equally well-prepared in science. Yet after we controlled for demographics, science dual enrollers earned significantly higher scores than college prep students in all three subjects. Information technology dual enrollers earned significantly higher scores in English and science and higher scores in math. In all three subjects, finance dual enrollers' scores were not statistically different than the scores of their college prep peers.

Both before and after we controlled for demographics and preparation levels, arts/technology dual enrollers outscored college prep students in English, but not significantly. They lagged slightly behind them in science and math, but, again, not significantly. In all three subjects, there were no statistically significant differences between marketing dual enrollers and their college prep peers.

Given the relatively low percentages of variability explained by our models, these results should be interpreted with caution. However, the models do provide some indication that the CTE concentrations of science, information technology, finance, arts/technology and marketing are college prep tracks. The remaining concentrations are not. This builds upon past studies that suggest that students in scientifically and technically-oriented concentrations dual enroll at higher rates and earn higher test scores in science than students in other concentrations.

(Hudson & Hurst, 1999; Levesque et al., 2011) But not every student interested in science or technology. Further, science is only one of several academic subjects students need to master in order to succeed in postsecondary education. These findings suggest that marketing, finance and arts/technology students may also be promising pathways to postsecondary and career preparation.

The flipside of these findings is that most of the 17 CTE concentrations are not producing students who are as academically well-prepared as their college prep peers, even when they take the same college prep coursework. Perhaps these concentrations are doing a good job of preparing students for careers. Analyses of post-high school salaries and employment rates are beyond the scope of this study. However, academically, concentrations such as transportation and manufacturing are serving as de facto lower tracks in the schools that were the subject of this study. If high schools are truly serious about preparing CTE concentrators for postsecondary education, they should perhaps limit the CTE concentrations they offer to those that produce students who are also academically well-prepared. Alternatively, they should consider increasing the academic rigor of the CTE coursework in the concentrations that are not currently producing college-ready graduates. At the very least, schools should disaggregate results by career concentrations in order to identify and address the strengths and weaknesses of each program. Otherwise, they risk remaining nineteenth century style sorting factories that provide some students with educational the opportunity to wash the dishes and others with the educational opportunity to own the restaurant.

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Appendix A

Explanations of CTE Concentrations

CTE Concentration	Description
Agriculture, food & natural resources	Food products and processing systems, plant systems, animal systems, power, structural and technical systems, natural resources systems, environmental services systems, agribusiness systems
Architecture & construction	Design/preconstruction, construction, maintenance/operations
Arts, A/V technology & communications	Audio and video technology and film, printing technology, visual arts, performing arts, journalism and broadcasting, telecommunications
Business, management &A8 administration	Management, business financial management and accounting, human resources, business analysis, marketing, administrative and information support
Education & training	Administration and administrative support, professional support services, teaching/training
Finance	Financial and investment planning, business financial management, banking and related services, insurance services
Government & public administration	Governance, national security, foreign service, planning, revenue and taxation, regulation, public management and administration
Health science	Therapeutic services, diagnostic services, health informatics, support services, biotechnology and research development
Hospitality & Tourism	Restaurants and food/beverage services, lodging, travel and tourism, recreation, amusements and attractions
Human services	Early childhood development and services, counseling and mental health services, family and community services, personal care services, consumer services
Information technology	Network systems, information support and services, interactive media, programming and software development
Law, public safety, corrections & security	Correction services, emergency and fire management services, security and protective services, law enforcement services, legal services
Manufacturing	Production, manufacturing, production process development, maintenance, installation and repair, quality insurance, logistics and inventory control, health, safety and environmental assurance

Marketing, sales & services	Management and entrepreneurship, professional sales and marketing, buying and merchandising, marketing communications and promotion, marketing information management and research, distribution and logistics, e-marketing
Science, technology, engineering & mathematics	Engineering and technology, science and math
Transportation, Distribution & Logistics	transportation operations, logistics, planning and management services, warehousing and distribution center operations, facility and mobile equipment maintenance, transportation systems/infrastructure planning, management and regulation, health, safety and environmental management, sales and service
Other Career/Technical Concentration	