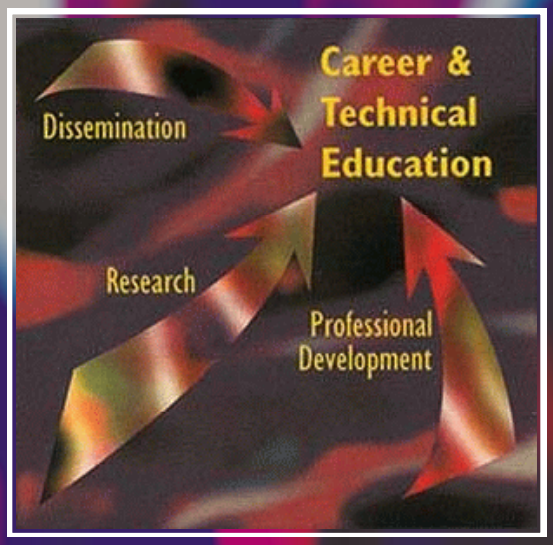


# The Postsecondary Achievement of Participants in Dual Enrollment: *An Analysis of Student Outcomes in Two States*

National Research Center for
Career and Technical Education
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# The Postsecondary Achievement of Participants in Dual Enrollment: An Analysis of Student Outcomes in Two States

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## EXECUTIVE SUMMARY

Dual enrollment programs enable high school students to enroll in college courses and earn college credit. Once limited to high-achieving students, such programs are increasingly seen as a means to support the postsecondary preparation of average-achieving students. Moreover, though dual enrollment programs typically have been reserved for academically-focused students, increasing numbers of career and technical education (CTE) programs are providing such opportunities to their students.

Despite the popularity and growth of dual enrollment programs, little is known about their efficacy. This report seeks to answer several questions regarding their effectiveness using rigorous quantitative methods. We examine the impact of dual enrollment participation for students in the State of Florida and in New York City. For both locations, we specifically examine postsecondary outcomes for participating CTE students; in Florida, we also examine the outcomes of dual enrollment participation for all students. We provide evidence that dual enrollment is a useful strategy for encouraging postsecondary success for all students, including those in CTE programs.

### What is Dual Enrollment, and Why is it Appropriate for CTE Students?

Dual enrollment programs are collaborative efforts between high schools and colleges in which high school students (usually juniors and seniors) are permitted to enroll in college courses. These programs provide students with a challenging academic experience and the opportunity to earn college credit prior to high school graduation. Unlike in other programs such as Advanced Placement and International Baccalaureate, dual enrollment students take actual college courses with a college syllabus, often on a college campus, rather than a college-level course intended to be taken by high school students.

Today a variety of policymakers, authors, educators, and foundations argue that many students, not only those with outstanding educational credentials, may benefit from participation in a dual enrollment program. In their view, dual enrollment is presumed to lead to a long list of positive outcomes for all participating youth, including increasing the academic rigor of the high school curriculum; helping low-achieving students meet high academic standards; providing more academic opportunities and electives in cash-strapped, small, or rural schools; reducing high school dropout rates and increasing student aspirations; helping students acclimate to college life; and reducing the cost of college for students.

This enthusiasm for expanding access to dual enrollment comes in part because dual enrollment mirrors the goals of two prominent trends in education, both driven by low rates of student success in college: increasing the rigor of secondary education and strengthening links between the secondary and postsecondary sectors. Dual enrollment is seen as addressing the need for increased high school rigor because it enables students to take college courses prior to high school graduation. And, as high schools and colleges partner to offer dual enrollment programs, proponents hope that communication and collaboration between the two sectors will increase in general.

Dual enrollment has also become a component of many CTE programs because its goals mirror those of a variety of CTE reforms, including upgrading the CTE curriculum and building upon the promise and addressing the shortcomings of previous CTE reform efforts.

## How Many Students Participate in Dual Enrollment?

Data on student participation in dual enrollment are only beginning to be collected. According to two 2005 reports from the U.S. Department of Education, 71 percent of U.S. high schools and 51 percent of U.S. postsecondary institutions permitted high school students to take college courses in 2002-03. In total, 813,000 secondary school students took a college-credit course during the 12-month 2002-03 school year.

Though longitudinal data are unavailable, program-level data indicate that participation in dual enrollment has increased in recent years. This growth is likely to continue. According to a 2006 scan of state policies, 42 states have policies pertaining to dual enrollment. Some states with standing legislation are considering revisions that would make dual enrollment accessible to more students. At the federal level, the Secretary of Education's Commission on the Future of Higher Education has expressed support for the expansion of dual enrollment programs.

## The Effectiveness of Dual Enrollment in Encouraging Postsecondary Persistence

Despite the popularity of dual enrollment, little is known about its effectiveness as a strategy for increasing students' postsecondary attainment. Two extensive reviews of the literature found almost no evidence that dual enrollment contributed to students' college access or academic success. Recent research has not increased our knowledge regarding dual enrollment's effectiveness either, as much of this work has been qualitative, exploring state policies or program features. Although these studies have identified promising program practices and indicate that dual enrollment may help students transition into college, they do not measure program effectiveness.

Studies that have attempted to look at dual enrollment outcomes tend to suffer from two shortcomings. First, they generally lack comprehensive data to include in their outcomes analyses, as few programs or states have comprehensive K-16 data systems. Second, they often do not use rigorous statistical methods to control for preexisting student characteristics, even when such data are available. Therefore, it remains unclear whether dual enrollment participation increases students' likelihood of entering college, preparedness for college-level work, or attainment of a college degree. Moreover, no research has focused on its impact for CTE students.

## Organization of the Report

This report uses statistical methods to examine the outcomes of dual enrollment participation for students in two large, well-established programs, one in Florida and one in New York City. We use datasets that span both high school and college student outcomes, enabling us to control for student characteristics. We pay particular attention to the impact of dual enrollment

participation on students enrolled in CTE courses of study in high school.

The report is organized as follows. After describing the methodology used, we turn to the findings for each program separately. The third section focuses on students in the State of Florida. The outcomes analyses in this section address dual enrollment participation generally as well as dual enrollment participation for CTE students specifically. The fourth section examines outcomes for CTE students who participated in New York City's College Now program. The fifth section of the report examines whether certain groups of students, such as males or those from low socioeconomic backgrounds, have different outcomes of participation in dual enrollment programs. In the final section, we offer conclusions and implications for programs and policy.

## Methods

The research questions for this study include the following:

1. What are the short-term effects of participation in a dual enrollment program, for all students and for CTE students, as measured by high school graduation and college enrollment rates?
2. What are the effects of participation in a dual enrollment program on all students' and CTE students' initial entry into postsecondary education, such as enrollment intensity, first-semester grade point average, and persistence to the second semester?
3. What are the long-term effects of participation in dual enrollment for all students and for CTE students, as measured by their persistence into the second year of postsecondary education, grade point average, and credit accumulation?
4. Do program effects vary by race/ethnicity, gender, socioeconomic status, or number of dual enrollment courses taken?

To answer these questions, we analyzed two existing large-scale administrative datasets using non-experimental methods, including ordinary least squares and logistic regressions.

The longitudinal nature of the data enabled us to control for preexisting student characteristics. Limiting analyses to only CTE students also provided us with an additional level of control for preexisting characteristics, because both CTE dual enrollment students and their non-participating peers had technically-oriented goals while in high school. Although we assume that these students are similar to one another in terms of motivation, career and academic aspirations, and high school experiences, this restriction will not necessarily eliminate all preexisting differences. Without a randomized design, we were unable to control for all possibly important preexisting characteristics. Positive findings may therefore be due to unmeasured factors that are not accounted for in our models rather than to dual enrollment participation. By not controlling for important factors affecting the decision to participate in dual enrollment, it is possible that our models may generate what appear to be positive impacts when in fact there are no such impacts or there are negative impacts. Future research should seek additional control variables as well as use experimental and quasi-experimental designs to establish a causal relationship between dual

enrollment participation and educational outcomes.

## Findings: Florida

Florida has a long-standing statewide dual enrollment program that is supported by state legislation. All high school students in the state who meet eligibility criteria (a 3.0 grade point average and passing the appropriate college placement exam for general education courses) must be offered the opportunity to participate in dual enrollment.

The State of Florida maintains a comprehensive student unit-record system for all students enrolled in the public education system. Using unique student identifiers, the data track students over time and across secondary and postsecondary public institutions in Florida. For this study, we had access to student records for the 2000-01 and 2001-02 high school graduating cohorts. Variables in the dataset included all courses taken in high school and college; dual enrollment courses and achievement in them; academic achievement measured as final high school grade point average and semester grade point averages in postsecondary education; and demographic information including age, gender, race/ethnicity, English language proficiency, and citizenship.

The State of Florida does not identify students as CTE concentrators. In order to determine which students were in CTE programs, we relied on the National Center for Education Statistics' definition of CTE participants: those who had completed three or more credits in a Specific Labor Market Preparation (SLMP) area (such as Technology and Communications, Health Care, or Business).

The analyses examined the impact of participation in dual enrollment on subsequent matriculation into and persistence in Florida postsecondary institutions. We conducted the analyses twice, once for all students in the state (to determine the effect of dual enrollment participation generally) and once for only students in CTE programs (to determine the effect of dual enrollment participation for this subgroup of students). The analyses included an array of control variables in order to minimize the influence of student characteristics (other than dual enrollment participation) on outcomes.

We ran each model for (1) the entire sample and (2) only students categorized as being in CTE programs of study. Then, because some authors have suggested that dual enrollment programs spanning multiple semesters may be more effective in improving outcomes for middle-achieving students, we conducted a second set of analyses that accounted for students' participation intensity, defined as the number of dual enrollment courses taken.

We found a positive relationship between dual enrollment participation and short- and long-term outcomes for both the full sample and the CTE sub-sample. **Dual enrollment was positively related to students' likelihood of earning a high school diploma.** For the full sample, students were 4.3 percent more likely than their peers to earn a diploma. CTE students who participated in dual enrollment were 1 percent more likely than their peers to earn a high school diploma.

**Participation in dual enrollment was positively related to enrollment in college for both the full sample and the CTE students. Dual enrollment participation also increased the likelihood of initially enrolling in a four-year institution** (by 7.7 percent for all students and 8.6 percent for CTE students). **For students who enrolled in postsecondary education, dual enrollment participation was also positively related to their likelihood of enrolling full-time.**

**Dual enrollment students, whether in the full sample or the CTE sub-sample, were statistically significantly more likely to persist in college to a second semester. They also had statistically significantly higher postsecondary grade point averages one year after high school graduation.** The difference ranges from as low as 0.21 points for all students to as high as 0.26 points for CTE students only.

**Of those students ever enrolled in postsecondary education, dual enrollment participation was positively associated with their likelihood of remaining enrolled two years after graduating from high school. Dual enrollment students' grade point averages after two years of college were also statistically significantly higher than their non-participating peers.** Both of these relationships held true for the full sample and the CTE sub-sample.

The relationship between dual enrollment participation and grade point average continued throughout students' postsecondary careers. **Dual enrollment students' cumulative college grade point averages three years after high school graduation were statistically significantly higher than those of their non-participating peers.** Finally, **dual enrollment students had earned more postsecondary credits three years after high school graduation (indicating that they had made more progress toward a degree).** For the full sample, dual enrollment students had earned 15.1 more credits than their non-dual enrollment peers. CTE dual enrollment students had earned 15.2 more credits than their non-dual enrollment CTE peers. Although some of these credits were likely earned through dual enrollment, it is also likely that some were earned after matriculation into postsecondary education.

Participation intensity had little impact on short- and long-term outcomes, however. The statistically significant effect of dual enrollment participation versus non-participation generally remained the same, regardless of whether students took one, two, three or four, or five or more dual enrollment courses.

## Findings: New York City

New York City's public university system, the City University of New York (CUNY), has a long-standing dual enrollment program, College Now. Every two- and four-year college in the CUNY system and nearly 300 high schools are involved. Between 2001 and 2006, 113,796 students participated in College Now.

The data collected from College Now come from two sources—the College Now office and the City University of New York's Office of Institutional Research. We had access to data

on students who graduated from any of the 19 vocational high schools in New York City and enrolled in CUNY in 2001 and 2002. The dataset included demographic variables, College Now courses taken by students and grades earned, information on students' high school academic performance, and semester-by-semester information on credits attempted, credits earned, and grades in all courses taken throughout the CUNY system.

The analyses examined the impact of participation in College Now on matriculation into and persistence in CUNY for CTE students. We ran each regression for the entire sample, comparing students with any degree of participation in College Now to their nonparticipating peers. Then, as with Florida, we conducted a second set of analyses that accounted for students' participation intensity.

Though not as consistently as in Florida, we also found positive short- and long-term outcomes of dual enrollment participation in New York City. **College Now participants were more likely than their peers to pursue a bachelor's degree. College Now participation was also positively related to students' first-semester grade point averages.** College Now participants had first-term grade point averages 0.133 points higher than those of non-participants. Finally, **College Now participation was positively related to students' overall progress toward a degree.** Three-and-a-half years after their initial enrollment in postsecondary education, College Now participants had earned significantly more college credits than their non-participating peers.

Unlike in Florida, we did find some influence of participation intensity in New York. Specifically, the positive relationship between College Now participation and first-semester GPA seems to be due to the impact of taking two or more courses, rather than on participation more generally. Additionally, although College Now participation by itself did not influence student full-time enrollment, students who took two or more College Now courses were 3.5 percent more likely to enroll full-time than non-participants (a statistically significant difference), whereas students who took one course were no more likely to do so. Intensity of participation appears to be more important for long-term outcomes. All three long-term outcome variables (persisting to the second year of college, grade point average after four semesters, and progress toward a degree) were positively related to College Now participation when intensity was taken into effect.

## Findings: Outcomes for Sub-groups

Part of the argument for expanding access to dual enrollment programs is based on an assumption that some types of students, particularly low-income or low-achieving students, may benefit from early exposure to the demands of college courses. This argument is based on evidence that such groups typically have less-positive postsecondary outcomes than their more advantaged peers and on a desire to help eliminate these gaps in college achievement. Thus, we examined whether the positive findings were particularly strong for certain sub-groups of students.

We ran separate regressions of the impact of dual enrollment for each of three sub-groups and then tested whether each group demonstrated similar marginal effects, using a standard *t*-test

at 5 percent levels. Statistical differences in effects can be treated as differences in gains from dual enrollment participation for the various sub-groups. Our analyses focused on differences in terms of gender (since males are increasingly underrepresented in higher education), high school achievement, and socioeconomic status.

Given the limited size of our New York City sample, we could examine differences only in outcomes in terms of gender. We found no significant differences between males and females. In Florida we were able to run analyses for all of the sub-groups. We found that, in many cases, **male and low-income students benefited more from dual enrollment participation than their peers.** On some measures, students with lower high school grades also benefited to a greater extent than students with higher grade point averages. On some measures, these sub-group differences were true for both the full sample and the CTE sub-sample; on other measures, the differences were found only for the full sample.

## Conclusions and Implications

The findings provide an encouraging, though not definitive, picture of dual enrollment as a strategy for encouraging student access to and persistence in postsecondary education. We find positive effects from participation in all areas, and though we would encourage future research to use additional control variables for student background and motivation, we believe there is evidence that dual enrollment can be an effective transition strategy for a range of students.

The findings have implications for policy and programs. First, they indicate that the spread of dual enrollment programs may be warranted and that states and programs should consider ways to encourage participation for a broad range of students. However, additional research is needed to further establish the efficacy of dual enrollment as a promising high school and CTE reform strategy, including analyses using randomized or quasi-experimental designs to eliminate some of the shortcomings of our regression analyses and further examining sub-group differences in outcomes in order to better understand which groups of students may benefit most from dual enrollment participation.

The implications of the findings presented in this report can be seen as pertaining to two separate arenas: dual enrollment generally, and CTE reform. These are as follows:

Dual Enrollment

1. Because dual enrollment participation can benefit a range of students, expand currently restrictive eligibility requirements for dual enrollment.
2. Consider creating dual enrollment sequences since our findings suggest that students benefit from taking more than one dual enrollment course.
3. Expand outreach to underserved populations and provide dual enrollment courses tuition-free for low-income students (if not for all students) in order to ensure that such students are able to take advantage of dual enrollment opportunities.

CTE Programs

1. Expand dual enrollment options for CTE students, particularly in places where these students are not currently offered dual enrollment opportunities.
2. Continue to integrate dual enrollment into CTE pathways and programs.

In conclusion, we present very encouraging, though not definitive, findings that dual enrollment participation is related to positive postsecondary outcomes. This positive association is particularly strong for groups of students who are struggling in postsecondary education, especially males and low-income students.

## INTRODUCTION

Dual enrollment programs enable high school students to enroll in college courses and earn college credit. Once limited to high-achieving students, these programs are increasingly seen as a means to also support average-achieving students' preparation for postsecondary education. Moreover, though they typically have been reserved for academically-focused students, increasing numbers of career and technical education (CTE) programs are providing dual enrollment opportunities to their students.

Despite their popularity and growth, little is known about the efficacy of dual enrollment programs. Do they help students better prepare for college? Do students who participate in dual enrollment enter and succeed in postsecondary education at rates higher than their peers who do not participate? Remarkably, there has been little research addressing these important questions.

This report seeks to answer some of these questions using rigorous quantitative methods. It examines the impact of dual enrollment participation on students in the State of Florida and in New York City. In both locations, we specifically examine postsecondary outcomes for CTE students, and in Florida we also examine those outcomes for all student participants. Our findings thus make a valuable contribution to the research and policy literature, providing evidence that dual enrollment is a useful strategy for encouraging postsecondary success for all students, including those in CTE programs.

### What is Dual Enrollment, and Why is it Appropriate for CTE Students?

Dual enrollment programs are collaborative efforts between high schools and colleges through which high school students (usually juniors and seniors) are permitted to enroll in college courses. Often credit earned in these courses also counts towards high school graduation requirements, an arrangement referred to as *dual credit.* In other cases, students earn only college credit. Under both arrangements, students are simultaneously enrolled in high school and college—thus, they are *dually enrolled* in the two institutions.[1] The college credit earned through dual enrollment is recorded on the students' college transcripts, just as it would be if they were regularly matriculated college students.

Like other credit-based transition programs such as Advanced Placement (AP) and International Baccalaureate (IB), dual enrollment programs provide students with a challenging academic experience and the opportunity to earn college credit prior to high school graduation. Unlike these other programs, however, dual enrollment students take an actual college course with a college syllabus, often on a college campus, rather than a college-level course intended to be taken by high school students. Achievement in dual enrollment courses is measured by the final

1 For simplicity's sake, we refer to all programs that allow high school students to enroll in college courses as *dual enrollment programs*. For a more nuanced description of the defining features of these programs and other credit-based transition programs, see Bailey and Karp (2003) and Karp, Hughes, Fermin, and Bailey (2004).

course grade, rather than the score received on an examination.

Dual enrollment programs vary widely in their structure and targeted students. They may be taught on a high school campus or at a college, by regular college professors or high school teachers certified as college adjuncts, and include college and high school students or high school students only. They vary in their eligibility requirements and target population. Sometimes, these variations are regulated by state policies; other times, program structure is determined through cooperative agreements between high schools and colleges.

As noted, dual enrollment programs have existed for many years but have typically targeted only the most advanced students. In recent years, increasing attention has been paid to the potential of dual enrollment programs to improve student outcomes for a wider range of young people. A variety of policymakers, authors, educators, and foundations have argued that many students, not only those with outstanding educational credentials, may benefit from participation in such programs. In their view, dual enrollment is presumed to lead to many positive outcomes for participating youth, including:

- *Increasing the academic rigor of the high school curriculum*, particularly for advanced students who complete their graduation requirements prior to the end of their senior year (American Association of State Colleges and Universities [AASCU], 2002; Boswell, 2001; Martinez & Bray, 2002).
- *Helping low-achieving students meet high academic standards* and lowering the need for remediation in postsecondary institutions (AASCU, 2002; Martinez & Bray, 2002; National Commission on the High School Senior Year [NCHSSY], 2001).
- *Providing more academic opportunities and electives* in cash-strapped, small, or rural schools (AASCU, 2002; Boswell, 2001; Venezia, Kirst, & Antonio, 2003).
- *Reducing high school dropout rates and increasing student aspirations*, particularly for students who do not have college-going role models in their families or communities, by providing them with challenging, motivating coursework (AASCU, 2002; Boswell, 2002).
- *Helping students acclimate to college life* by exposing them to the reality of postsecondary education (Martinez & Bray, 2002; Venezia et al., 2003).
- *Reducing the cost of college* by enabling students to earn college credit (in many cases for free) and shortening their time to degree (AASCU, 2002; Boswell, 2001; Martinez & Bray, 2002).

As we will see later in this report, evidence that these outcomes actually accrue through dual enrollment participation is sparse. However, dual enrollment's potential benefits for many students of varying academic backgrounds have been attractive to many educators and policymakers. In part, this is because dual enrollment mirrors the goals of two prominent trends in education: increasing the rigor of secondary education, and improving links between the secondary and postsecondary sectors.

Both of these trends are driven by low rates of student success in postsecondary education. There is substantial evidence that, despite students' desire to obtain college degrees (National Center for Education Statistics [NCES], 2004) and the economic benefits of doing so (Grubb, 2002; NCES, 2003), many young people will not earn postsecondary credentials. According to the National Center for Education Statistics (NCES) (2005), almost two-thirds of high school graduates enter postsecondary schools immediately after high school. Yet many young adults do not attain a postsecondary credential. In 2003, 57 percent of high school graduates aged 25-29 had completed some college, but only 28 percent held a bachelor's degree (NCES, 2005).

In addition to the low rates of persistence and graduation, many students entering postsecondary education are unprepared for college-level work. Though they may have successfully completed high school requirements, many are placed into remedial or developmental coursework. In essence, such students are in college without actually being "in college"—without taking college-level courses (Deil-Amen & Rosenbaum, 2002). Nearly 60 percent of the first-time community college students in the National Education Longitudinal Study of 1988 (NELS:88) took at least one remedial course, as did 29 percent of first-time students in public four-year institutions (Attewell, Lavin, Domina & Levey, 2006).

A consequence of high remediation rates is that the time it takes for students to earn their degree is extended, often forcing students to take out additional loans or forgo more future wages than if they had immediately entered credit-bearing courses. Perhaps most importantly, students required to take many remedial courses are more likely to drop out of college before receiving a degree than their counterparts who need less remediation (Deil-Amen & Rosenbaum, 2002).

Dual enrollment is seen by its proponents as addressing the need for greater high school rigor because it enables students to take college courses prior to high school graduation. And because dual enrollment programs demand that colleges and high schools work together, such proponents also anticipate that communication and collaboration between the two sectors will increase. Thus, they hold, dual enrollment may simultaneously prepare students for the academic demands of postsecondary education and create a seamless transition between high school and college.

These arguments and educational trends have set the stage for expanding dual enrollment to students not at the top of the academic achievement hierarchy. But to include CTE students—who in previous eras may have been seen as not needing to be prepared for college—seems to be an even larger departure from dual enrollment as it traditionally has been envisioned. However, dual enrollment has become a component of many CTE programs, since it reflects the goals of a variety of CTE reforms.

First, dual enrollment helps upgrade the CTE curriculum. With the increasing recognition that postsecondary credentials are necessary for entry into even many non-professional jobs, CTE educators and advocates have argued that career and technical programs must increase their academic rigor (Weiner, 2005). CTE students can no longer be prepared only to enter the workforce immediately after high school; they must also have the academic skills to attend college if

they desire. As with upgrading the high school curriculum more generally, dual enrollment may help increase the rigor of CTE program curricula.

Second, dual enrollment builds upon the promise and addresses the shortcomings of previous CTE reform efforts, particularly the Tech Prep program. A key shortcoming of Tech Prep was that students often did not benefit from its credit-in-escrow or articulated coursework model (Bragg, 2001; Hughes, Karp, Fermin, & Bailey, 2005). Many Tech Prep programs are now turning to dual enrollment courses rather than articulated coursework as a way to provide CTE students with high-level academic and technical experiences. Support for this approach is seen in a variety of national initiatives. In 2003, the federal government proposed replacing the Carl D. Perkins Vocational and Technical Education Act with the Secondary and Technical Education Act. A cornerstone of the proposed legislation was the expansion of dual enrollment opportunities for students in technical courses of study (Office of Vocational and Adult Education [OVAE], 2003). Though the proposed legislation was not passed, more recent efforts have sought to include dual enrollment in CTE. For example, the U.S. Department of Education's College and Career Transitions Initiative (CCTI) encourages the creation of career pathways that include dual enrollment experiences for students.

Finally, dual enrollment enables high schools to offer students CTE opportunities without having to invest in costly technical equipment. Many schools, particularly those in small or cash-strapped districts, cannot afford the equipment necessary to prepare students for technical fields, but community colleges often invest in such equipment. By enabling high school students to take courses on a college campus where such resources are available, high school CTE programs can expand options for students without additional drain on their resources.

## How Many Students Participate in Dual Enrollment?

Data on student participation in dual enrollment are only beginning to be collected. In 2002-03, 11,700 U.S. public high schools—71 percent—offered courses for dual credit (Waits, Setzer, & Lewis, 2005). That same year, 51 percent of Title IV postsecondary institutions permitted high school students to enroll in college credit courses (Kleiner & Lewis, 2005). In total, 813,000 students took a college credit course during the 12-month 2002-03 school year (Kleiner & Lewis, 2005).

Though longitudinal data are unavailable, program-level data indicate that participation has increased in recent years. In New York City, the number of students participating in the City University of New York's College Now program increased 70 percent between 2001 and 2004 ("Partnership for Student Achievement," n.d.). By 2003-04, there were over 13,000 enrollments in college-credit College Now courses. In Texas, the percentage of high school students taking dual enrollment courses grew from 4.8 percent to 15.6 percent between 1990-91 and 2001-02 (O'Brien & Nelson, n.d.). The number of Florida students participating in dual enrollment grew from 27,689 in 1988-89 to 34,273 in 2002-03 ("Florida Dual Enrollment Participation Data," n.d.).

This growth is likely to continue. According to the most recent analysis of state policies, 42 states have policies pertaining to dual enrollment (Western Interstate Commission for Higher Education, 2006). Some states with standing legislation are considering revisions that would make dual enrollment accessible to more students. For example, in 2005, Tennessee considered legislation that would use state lottery proceeds to fund student tuition in dual enrollment programs. Other states are making dual enrollment a key piece of their high school reform efforts. New Jersey implemented its Twelfth Grade Option program to make the senior year of high school more meaningful to students. Students can participate in a variety of enrichment activities, with dual enrollment participation being one of the most prominent and popular. The National Governors Association (2005) has also expressed its support for dual enrollment as a high school reform strategy. At the federal level, the Secretary of Education's Commission on the Future of Higher Education (2006) has expressed support for the expansion of dual enrollment programs.

## The Effectiveness of Dual Enrollment in Encouraging Postsecondary Persistence

Despite the popularity of dual enrollment programs, little is known about their effectiveness as a strategy for increasing students' postsecondary attainment. In an extensive review of the literature, Bailey and Karp (2003) found almost no evidence that dual enrollment contributed to students' college access or academic success. After reviewing 45 articles and reports on dual enrollment, they determined that few studies have explored student outcomes, making it difficult to discern whether participants succeed in college at rates higher than their peers. The studies of dual enrollment outcomes that Bailey and Karp did identify rarely accounted for confounding factors such as student characteristics, prior student achievement, or student motivation.

More recent research has not increased our knowledge regarding dual enrollment's effectiveness. Much of this work has been qualitative, exploring state policies (Hoffman, 2005; Karp, Bailey, Hughes & Fermin, 2004, 2005) or program features (Hughes et al., 2005). These studies have identified promising program practices and indicate that dual enrollment may help students transition into college. One study of a technical dual enrollment program focusing on the health professions, for example, found that the program was implemented as intended and seemed to encourage students to pursue postsecondary education in health-related fields (Hughes et al., 2005). None of these studies, however, measured program effectiveness.

A recent review of the literature (Lerner & Brand, 2006) drew similar conclusions. In reviewing 22 studies on dual enrollment and similar programs, most conducted by programs themselves, the authors found that few studies effectively measured program outcomes. This was often due to a lack of adequate data or a focus on qualitative aspects of program implementation rather than measurable student outcomes.

Studies that attempt to look at dual enrollment outcomes tend to suffer from two shortcomings. First, they generally lack comprehensive data to include in their outcomes analyses. Few studies are able to track students from high school into postsecondary education, as few pro-

grams or states have comprehensive K-16 data systems.[2] As a result, analyses of dual enrollment either focus on high school completion and other short-term outcomes or examine long-term outcomes but cannot control for differences between dual enrollment and non-dual enrollment students at the high school level. They may also focus on very small programs, using datasets with small numbers of students, thereby limiting their generalizability.

Second, dual enrollment studies often do not use rigorous statistical methods to control for preexisting characteristics, even when such data are available. For example, many studies compare the college success rates of dual enrollment students to their non-dual enrollment peers without examining possible reasons for success outside of dual enrollment participation. They do not take into account student success in high school or other characteristics that may influence college success independently of dual enrollment participation. This may be due to lack of data, as previously discussed, or lack of capacity at the program or state level to undertake such analyses.

Some attention is now being paid to examining dual enrollment outcomes using comprehensive data sets and rigorous methods. The City University of New York (CUNY), which runs the large College Now dual enrollment program, has done some preliminary analyses of student outcomes, and though this work is unpublished and was conducted for internal purposes, it is the most thorough investigation of dual enrollment outcomes to date. Controlling for student characteristics, these analyses found that dual enrollment participants had a greater likelihood than their CUNY classmates of persisting to a third semester of college (Michalowski, 2006; Skadberg, 2005).

Research conducted in Florida indicates that dual enrollment may encourage student success in college. Among students who had high school grade point averages of 3.0 or higher and enrolled in a community college the fall following high school graduation, dual enrollment participants were more likely to earn an associate degree within four years than non-participants (Florida Department of Education, 2004). However, this study examined only a small sample of students and did not use statistical techniques to control for preexisting student characteristics.

Overall, it remains unclear whether dual enrollment participation increases students' likeliness to enter college, preparedness for college-level work, or attainment of a college degree. Moreover, no research focuses on the impact of dual enrollment participation on CTE students.

## Organization of the Report

This report employs statistical methods to examine the outcomes of dual enrollment participation for students in two large, well-established dual enrollment programs, one in Florida and one in New York City. It uses datasets that span both high school and college, enabling us to control for student characteristics. We pay particular attention to the impact of participation on students enrolled in CTE courses in high school. Thus, this study makes two unique contributions to the literature: it provides one of the first comprehensive, rigorous examinations of dual

2 This fact has been discussed at length elsewhere in reference to college transition issues; see the Data Quality Campaign, www.dataqualitycampaign.org, for more details.

enrollment outcomes and the first examination of the impact of dual enrollment participation on CTE students. Both of these contributions should help inform current policy and programmatic debates regarding the appropriateness of expanding dual enrollment to a wider range of students.

The remainder of the report is organized as follows. The next section describes the methodology of the study. It outlines our research questions and describes our statistical methods, including the advantages and disadvantages of the non-experimental design used. It then turns to the findings for each program.

The third section focuses on students in the State of Florida. This section describes dual enrollment in Florida, the dataset used for our analyses, and demographic characteristics of the sample. The outcomes analyses in this section address dual enrollment participation generally as well as dual enrollment participation for CTE students specifically, and provide demographic information for both groups of students. This section then provides short- and long-term outcomes analyses for all dual enrollment students compared to their non-dual enrollment peers and for CTE students who participated in dual enrollment compared to their CTE peers who did not participate in the program.

The fourth section examines outcomes for CTE students who participated in New York City's College Now program. It describes the program and our dataset, the variables included in the analysis, and the demographic characteristics of our sample. Finally, it provides short- and long-term outcomes.

The fifth section of the report examines whether certain groups of students have different outcomes from dual enrollment participation. The study is particularly interested in whether dual enrollment can increase postsecondary success for male students and students from low socioeconomic backgrounds, given these groups' underrepresentation in higher education. The final section of the report offers conclusions and implications for programs and policy.

## METHODS

The research questions for this study address the gap in the literature regarding the impact of dual enrollment participation, particularly for CTE students. They include:

1. What are the short-term effects of participation in a dual enrollment program, for all students and for CTE students, as measured by high school graduation and college enrollment rates?
2. What are the effects of participation in a dual enrollment program on all students' and CTE students' initial entry into postsecondary education, such as enrollment intensity, first-semester grade point average, and persistence to the second semester?
3. What are the long-term effects of participation in dual enrollment for all students and for CTE students, as measured by their persistence into the second year of postsecondary education, grade point average, and credit accumulation?
4. Do program effects vary by race/ethnicity, gender, socioeconomic status (SES), or number of dual enrollment courses taken?

To answer these questions, we analyzed existing large-scale administrative datasets. These analyses used non-experimental methods, including ordinary least squares and logistic regressions, and controlled for various student and school characteristics. However, some important student characteristics—such as motivation—were not available in our datasets. If dual enrollment participants are fundamentally different from non-participants even after adjusting for observable covariates, then the estimated effect of the program may, in part, be attributable to preexisting differences in unmeasured or unobserved student factors.

In this section, we describe the datasets and methods used and provide an overview of the advantages and disadvantages of our general approach. In later sections, we discuss each dataset individually and provide additional details specific to the dataset under discussion.

### Datasets

The study used data on two large dual enrollment programs, one in New York City and the other in Florida. The New York City dataset included 2,303 records, and the Florida dataset included 299,685. The New York dataset included only students who attended one of New York City's 19 vocational high schools and enrolled in the City University of New York (CUNY) after graduation. In contrast, the Florida dataset had records for all students enrolled in a Florida public high school, whether they were CTE students or not.[3]

Both datasets contained student unit records, allowing us to track individual students over time. Each dataset included two cohorts of students and followed those students for up to

3 It did not, however, provide postsecondary data for students who enrolled in college in a private institution or outside of the state.

four years of postsecondary enrollment. Both also included variables that enable researchers to control for students' high school academic performance, socioeconomic status, and high school experiences, though to varying extents. We were also able to obtain high school- and neighborhood-level information from the Common Core Dataset (CCD) and the 2000 Census using high school identifiers and zip codes.

## Empirical Strategy

We undertook separate analyses of each of the datasets. For New York City, we examined only the effects of dual enrollment participation for CTE students as compared to their CTE peers who did not participate in dual enrollment. For Florida, we were able to run two sets of analyses: one comparing all dual enrollment participants to non-dual enrollment participants, and one comparing only CTE dual enrollment students to their CTE peers who did not participate in dual enrollment. In addition, because the New York City data included only students who enrolled in the City University of New York, we were unable to analyze the impact of dual enrollment on high school outcomes. The Florida data, however, enabled us to explore some short-term dual enrollment outcomes such as high school diplomas earned; the Florida data also enabled us to compare students who did not enroll in postsecondary education to their peers who did so.

Prior to conducting the impact analyses, we conducted descriptive analyses using both datasets. We examined the types of students who enrolled in dual enrollment compared to those who did not in terms of their preexisting demographics (age, race/ethnicity, gender, limited English proficiency, citizenship, SES) and academic characteristics (high school grades, several test scores). We also compared these groups in terms of educational outcomes such as high school graduation, college enrollment, intensity of college attendance, and educational outcomes, including first-semester grade point average, course completion, retention, transfer, and credit accrual. In all of these comparisons, we used standard statistical estimators (means and standard errors).

Then we used a regression-adjusted approach to examine the effectiveness of dual enrollment in both states, using STATA statistical software. This non-experimental method allows us to adjust for observable differences between dual enrollment and comparison students. The basic form of the model is:

$$y_i = \beta_0 + \beta_1 DE_i + \beta_2 X_i + \beta_3 Z_i + \varepsilon_i$$

where $y_i$ is the outcome variable of interest; DE equals 1 if the student participated in dual enrollment and 0 otherwise; $X_i$ and $Z_i$ are vectors that include student and high school characteristics, respectively; $\varepsilon_i$ is a random error term that captures the effect of unmeasured factors; and $\beta_0, \beta_1, \beta_2,$ and $\beta_3$ are parameters to be estimated. Although $\beta_0, \beta_2,$ and $\beta_3$ are important parameters, the main interest here is $\beta_1$, the impact of dual enrollment on student educational outcomes.

For each outcome variable of interest, we conducted a series of regressions. First, we conducted a baseline analysis using the outcome variable as the dependent variable and the indicator for dual enrollment student or not ($DE_i$) as the main independent variable. Then, in order to adjust for observable and high school differences between dual enrollment and comparison students, we added a series of covariates to the analysis ($X_i$ and $Z_i$). These included factors such as race/ethnicity, gender, limited English proficiency, high school grade point average, and high school quality indicators.[4]

We estimated the parameters in the equation above using ordinary least squares and logistic regression for continuous and binary outcomes respectively. However, the parameters of a logistic regression are not the marginal effects (Maddala, 1983)—i.e., the percentage increase in the dependent variable given a unitary increase in an independent variable, holding the other independent variables constant. Therefore, we computed and report marginal effect to provide a clearer interpretation of the magnitude of the effects that dual enrollment participation had on educational outcomes. In addition, we report Huber-White robust standard errors to account for correlations of error terms across observations (White, 1980).

### Advantages and Disadvantages of the Study Design

As noted, the non-experimental nature of this study's design has methodological strengths and weaknesses. Some of these are specific to the individual datasets and are discussed in detail later. More generally, the study greatly improves on methodologies used in previous examinations of dual enrollment outcomes. First, the longitudinal nature of the data enables us to control for preexisting student characteristics, something that most other studies have been unable to do. Most importantly, we can control for the fact that in general, dual enrollment students are more successful in high school than their non-dual enrollment peers. Longitudinal data also allow us to follow students beyond high school graduation and examine longer-term impacts of participation in dual enrollment.

Limiting analyses to only CTE students also provides us with an additional level of control for preexisting characteristics. In the CTE analyses, we knew that all of the students—both in the control and dual enrollment groups—had technically-oriented goals while in high school, as both groups of students elected to participate in CTE-focused curricula. Therefore, we would expect them to be similar (though not necessarily identical) in terms of motivation, career and academic aspirations, and high school experiences. We believe that comparing CTE students may help to minimize any potential bias due to self-selection into dual enrollment, although this restriction will not necessarily eliminate all preexisting differences.

The large sample sizes and presence of students from two programs enable us to generalize our results to a larger population than would be possible using data from only one or two colleges. This is particularly true for the Florida dataset, which includes all high school students in the state.

4 Due to the restricted sample size in New York, we selected these covariates using correlation matrices to determine which indicators had potentially confounding effects in the analyses.

However, the design does have some shortcomings. The largest of this is our inability to control for all potentially important preexisting characteristics, given that we do not have a randomized, or experimental, design. Although we include controls for student characteristics such as academic achievement and demographic background in our models, we are limited by the variables contained in the dataset. These variables, though well-established and commonly used in research, are imperfect. For example, socioeconomic status (SES) is a complex concept that includes family income as well as family educational background and cultural resources. The variables available to us to measure SES are measures such as students' receiving free or reduced lunch in middle school—a proxy measure for family income that does not capture all aspects of SES. Thus, other features of student SES that might influence a student's choice to take a dual enrollment course or postsecondary outcomes may not be captured in the models. Likewise, although we can account to a degree for prior academic achievement, we cannot account for unmeasured characteristics such as motivation that may influence students' likelihood of entering and persisting in college.

Given these shortcomings, it is important to interpret the results with caution. Positive findings may well be due to student participation in dual enrollment. However, it is important to recognize that other unmeasured factors, such as student motivation or parental encouragement and support, are likely correlated with participation in dual enrollment and are also likely to generate a positive effect. By not controlling for important factors affecting a student's decision to participate in dual enrollment, it is possible that our models may generate what appear to be positive impacts when in fact there are no such impacts or there are negative impacts. In other words, if dual enrollment participants are fundamentally different from non-participants even after adjusting for observable covariates, then the estimated effect of the program may, in part, be attributable to preexisting differences. Future research should seek additional control variables as well as use experimental and quasi-experimental designs to establish a causal relationship between dual enrollment participation and educational outcomes.

## FINDINGS: FLORIDA

Florida has a long-standing statewide dual enrollment program supported by state legislation. All students in the state who meet the eligibility criteria must be offered the opportunity to participate in dual enrollment. In Florida, dual enrollment is generally targeted at high-achieving students, with the state requiring that participants have an unweighted grade point average of 3.0. There is one exception to this, codified in state law, permitting students to take courses that do not lead to an Associate's degree (such as courses leading to technical certificates) if they have an unweighted GPA of 2.0; these courses may still generate college credits, however, and thus are included in our analyses. Students must also pass the college placement test in the subject area in which they will be taking a dual enrollment course in order to participate in the program.

In Florida, dual enrollment may occur either on a college campus or at the high school. Students take an array of courses, most frequently general education courses. The specific courses offered for dual enrollment are determined through joint agreements between colleges and local high schools. Dual enrollment in Florida is within the purview of community colleges, and the vast majority of dual enrollments occur in two-year rather than four-year institutions.

The number of Florida students participating in dual enrollment grew from 27,689 in 1988-89 to 34,273 in 2002-03 (*Florida Dual Enrollment Participation Data,* n.d.). According to the Florida Legislature's Office of Program Policy Analysis and Government Accountability, 17 percent of the 2002 graduating high school class took at least one dual enrollment course (Fletcher, 2006).

### Florida Dataset

The State of Florida maintains a comprehensive student unit record system for all students enrolled in the state's public education system in its K-20 Education Data Warehouse. (Florida is a leader in this area, and many other states are now making efforts to emulate Florida's Data Warehouse.) The Data Warehouse is a rich dataset extracted from multiple sources that follows students from their first years in public school through postsecondary education. Using unique student identifiers, the data track students over time and across secondary and postsecondary public institutions in Florida.

For this study, we had access to student records for the 2000-01 and 2001-02 high school graduating cohorts. This included all students in these cohorts: both CTE and non-CTE students and dual enrollment participants and non-participants. The sample included 299,685 students.

The Florida dataset includes a rich array of high school and postsecondary variables. These include all courses taken in high school and college; dual enrollment courses and achievement in these courses; academic achievement measured as final high school grade point average and semester grade point averages in postsecondary education; and demographic information including age, gender, race/ethnicity, English language proficiency, and citizenship.

The State of Florida does not identify students as CTE concentrators in their data. In order to determine which students were enrolled in career and technical programs, we relied on the NCES definition of CTE participants: those who had completed three or more credits in a Specific Labor Market Preparation (SLMP) area (such as Technology and Communications, Health Care, or Business). Thus, we adhered to the NCES definition of occupational concentrators (Levesque, 2003a, 2003b).

Using the data files provided by the State of Florida, we used the Secondary School Taxonomy created by NCES to assign each high school and college course included in the dataset to a labor market preparation area. A dual enrollment course in a labor market preparation area could count as one of the three courses. We then coded transcript data to determine if they had taken three or more credits in the same area, creating a categorical variable identifying which students had done so (CTE students) and which had not (non-CTE students).

The dataset had many advantages, most notably its size and completeness. However, it did have some shortcomings. First, it included only students enrolled in Florida's public postsecondary institutions. Students who matriculated into colleges outside the state or private institutions in Florida were not included in the postsecondary variables. In other words, these students appeared not to have attended college, when in fact, they may have enrolled in a private college or one outside the state.

Second, while we have students' final high school grade point averages, we do not have their academic achievement prior to their dual enrollment participation. The final GPA variable captures students' high school academic achievement generally, and while it includes primarily courses taken prior to dual enrollment participation, it also includes coursework taken during and/or following participation. If one of the benefits of dual enrollment is improving high school grades, then controlling for grades that include dual enrollment courses will actually lower the estimate of the relationship between dual enrollment and subsequent educational outcomes.

Finally, our socioeconomic status variable is also incomplete. We rely on a single dummy variable indicating whether students were ever eligible for free or reduced lunch in middle school. Because we do not have any other individual SES variables, we use school-level variables, described below, as additional proxies for student SES.

## Variables Included in the Analysis

The analyses in this study examined the impact of participation in dual enrollment on subsequent matriculation into and persistence in Florida postsecondary institutions. We conducted the analyses twice: once for all students in the state (to determine the effect of dual enrollment participation generally) and once for only students in CTE programs (to determine the effect of dual enrollment participation for this sub-group of students).

*Participation* in dual enrollment was defined as enrolling in a college course while in

high school and was identified using student records provided by the K-20 Education Data Warehouse. As noted in the previous section, *CTE students* were defined as students who took three courses in the same specific labor market preparation area while in high school.

We examined the relationship between dual enrollment participation and a variety of outcomes. The measures were all taken from the data provided by the Florida K-20 Education Data Warehouse. Outcomes variables included:

*High school diploma:* This variable indicates whether students earned a high school diploma. Florida offers a number of diplomas, including a certificate of completion and the GED. This variable indicates that students earned any type of high school diploma or GED; students with no diploma or certificate of completion constitute the reference group.

*Postsecondary enrollment:* This variable indicates whether or not students enrolled in a Florida public postsecondary institution (either two-year or four-year) at any point following graduation from high school.

*Full-time enrollment:* This variable indicates whether students were enrolled full-time (12 credits or more) or part-time during their first semester of postsecondary education. We considered this an outcome, rather than a co-variate, because some have hypothesized that dual enrollment may increase student aspirations or commitment to college, thereby encouraging them to enroll full-time. Given evidence that full-time students are more likely to persist in college (Horn & Carroll, 1996), this would be a positive impact of dual enrollment participation.

*State university system (SUS) enrollment in first term:* This variable indicates whether students were enrolled in a public four-year institution during their first semester of postsecondary education.

*First-year grade point average (GPA):* This variable is students' postsecondary grade point average, counting grades from any course that was completed by one year from the date of high school graduation. Note that this is calculated from the time of high school graduation rather than the time of postsecondary enrollment.

*Second-year GPA:* This variable is students' postsecondary GPA two years after high school graduation. Again, note that this is calculated from the time of high school graduation rather than the time of postsecondary enrollment.

*Cumulative postsecondary GPA:* This variable is students' cumulative postsecondary grade point average as of three years after high school graduation, again calculated from the time of high school graduation.

*Postsecondary credits earned:* This variable includes the total postsecondary credits earned three years after high school graduation, calculated using students' postsecondary transcripts.

*Persistence to second term:* This variable indicates whether or not students were enrolled in postsecondary education two semesters after high school graduation. Note that students who were not enrolled in college the fall following high school graduation but enrolled in the spring would be considered to have persisted to the second semester under this definition.

*Persistence to second year:* This variable indicates whether or not students were enrolled in postsecondary education one year following high school graduation. Again, note that some students may not have enrolled in postsecondary education immediately following high school graduation but enrolled the following year. These students would be considered to have persisted to the second year.

The analyses included an array of control variables in order to minimize the influence of student characteristics other than dual enrollment participation on outcomes. In the first model of each analysis, we included demographic variables: gender, race/ethnicity, cohort year, disability, English proficiency, and eligibility for free or reduced lunch. In the second model, we added student achievement as measured by high school grade point average. In the third and final model, we added school-level controls, including proportions of black and Hispanic students, charter school status, school grade,[5] school location, proportion of residents living in the same zip code as the school with college or higher education, and median household income of residents living in the same zip code as the school. These last two variables were generated by obtaining the zip codes of each high school using the Common Core of Data and then using Census 2000 data to determine the education levels and household incomes of those residing in the same census tracts as each school. These variables served as proxies for the socioeconomic status of students attending each high school.

We ran each model for the entire sample, and then again including only students categorized as being in CTE programs of study. Then, because some authors (Bailey & Karp, 2003; Hughes et al., 2005) have suggested that dual enrollment programs spanning multiple semesters may be more effective in improving outcomes for middle-achieving students, we conducted a second set of analyses that accounted for students' participation intensity. We re-ran the regressions including students' intensity of dual enrollment—variables for taking one dual enrollment course, two courses, three or four courses, and five or more courses, leaving those without any participation in dual enrollment as the reference group. This enabled us to explore whether increased exposure to many college courses was more strongly related to student postsecondary outcomes than exposure to only a few. As before, we included all of the same controls in these sets of analyses that we included in the first set.

## Descriptive Statistics

Prior to running the outcomes analyses, we explored the demographic characteristics of students in the Florida sample. This included comparing the characteristics of the entire sample

5 Florida grades its schools from A-F based on their performance on accountability measures. These grades serve as a proxy for school quality.

to the characteristics of the CTE sub-sample. Table 1 illustrates the findings. Both the full sample and the CTE sub-sample are disaggregated by dual enrollment participation.

*Table 1.* Characteristics of the Florida Sample

| | | All Students | | CTE Students[2] | | |
|---|---|---|---|---|---|---|
| Variables | Florida Sample | Non-DE Students | DE Students[1] | All | Non-DE Students | DE Students[3] |
| *Student Characteristics* | | | | | | |
| Female | 50.74% | 49.19% | 62.03% | 52.97% | 51.43% | 64.12% |
| White & non-Hispanic | 54.93% | 52.00% | 76.28% | 59.79% | 57.97% | 73.03% |
| Black & non-Hispanic | 23.96% | 25.75% | 10.95% | 21.97% | 23.07% | 13.90% |
| Hispanic | 17.76% | 19.10% | 8.05% | 15.27% | 16.16% | 8.77% |
| Asian & Pacific Islander | 2.53% | 2.35% | 3.84% | 2.16% | 2.00% | 3.27% |
| American Indian | 0.24% | 0.23% | 0.29% | 0.28% | 0.27% | 0.37% |
| Disability | 10.87% | 12.06% | 2.26% | 8.81% | 9.62% | 2.90% |
| Limited English Proficiency | 4.59% | 5.12% | 0.72% | 2.17% | 2.42% | 0.32% |
| Ever in MS free/reduced lunch program | 42.51% | 45.46% | 23.01% | 43.07% | 44.96% | 29.87% |
| HS GPA | 2.66 | 2.58 | 3.27 | 2.79 | 2.73 | 3.22 |
| | (0.74) | (0.73) | (0.49) | (0.58) | (0.57) | (0.44) |

*Note:* Standard deviations for continuous variables are in parentheses.
[1] DE students are all individuals who took at least one DE course while enrolled in high school.
[2] CTE students are all individuals who enrolled in three or more CTE courses.
[3] DE students are those CTE students who also took at least one DE course.

Among the full sample, dual enrollment students were more likely to be female and white and less likely to be Black or Hispanic than their non-participating peers. Dual enrollment students were also less likely to be labeled as Limited English Proficient or to have been eligible for free or reduced lunch in middle school. Not surprisingly, given the state's eligibility requirements, dual enrollment students had higher grade point averages in high school than those who did not participate. In short, the dual enrollment sample was more advantaged in terms of demographic and academic characteristics than their non-dual enrollment peers.

Among CTE students, dual enrollment students were also more advantaged than their non-dual enrollment peers. It is possible that dual enrollment students participated in CTE programs focused on high-technology or high-skill occupations such as computer networking or engineering, which have often encouraged college enrollment, while non-dual enrollment students participated in more traditional CTE fields with less well-developed college connections. These differences may also reflect state requirements for dual enrollment participation or student motivations and college aspirations.

Like the full sample, CTE dual enrollment students were more likely than their peers to be female or white and less likely to be Black or Hispanic. Dual enrollment students were also less likely to have a disability, be labeled as Limited English Proficient, or receive free or reduced lunch

in middle school. Dual enrollment students had higher grade point averages than their non-participating peers. In many ways, dual enrollment CTE students were more similar to their non-CTE dual enrollment classmates than to their CTE peers who did not participate in dual enrollment.

Tables 2 and 3 illustrate students' dual enrollment patterns. Within both samples, the highest percentage of students took two dual enrollment courses; these may or may not have been part of a sequence. A relatively high percentage of students, both in the full sample and in the CTE sub-sample, also took five or more dual enrollment courses. Not surprisingly given the state's policy, most dual enrollment students had grade point averages in the top quartile. However, all four quartiles are represented in the sample, suggesting that the state eligibility restrictions were not strictly followed by all institutions.

*Table 2.* Number of Dual Enrollment Courses Taken by the Florida Sample

| | All Students | | CTE Students | |
|---|---|---|---|---|
| Number of Dual Enrollment Courses Taken | Observations | Percentage | Observations | Percentage |
| None | 263,468 | 87.9% | 33,825 | 87.9% |
| 1 | 7,640 | 2.5% | 1,124 | 2.9% |
| 2 | 11,094 | 3.7% | 1,465 | 3.8% |
| 3-4 | 7,864 | 2.6% | 962 | 2.5% |
| 5+ | 9,619 | 3.2% | 1103 | 2.9% |
| Subtotal (participants) | 36,217 | 12.1% | 4,654 | 12.1% |
| Total | 299,685 | 100% | 38,479 | 100% |

*Table 3.* High School Grade Point Average of Dual Enrollment Participants in Florida

| Variables | Non-Dual Enrollment Students | Dual Enrollment Students | Percentage of Dual Enrollment Students | Total Observations |
|---|---|---|---|---|
| 1st quartile (0-2.263) | 73,861 | 1,053 | 1.4% | 74,914 |
| 2nd quartile (2.263-2.7) | 72,334 | 2,755 | 3.7% | 75,089 |
| 3rd quartile (2.701-3.167) | 65,731 | 9,034 | 12.1% | 74,765 |
| 4th quartile (3.167-4.0) | 51,507 | 23,372 | 31.2% | 74,879 |
| All dual enrollment participants | 263,433 | 36,214 | 12.1% | 299,647 |

Not surprisingly, when we looked at outcomes prior to controlling for preexisting characteristics, dual enrollment students appeared to be more successful in college than their peers, as illustrated in Table 4. For the full sample, dual enrollment students were more likely to earn a high school diploma and to enroll in college (of any type). Of those students who enrolled in college, dual enrollment participants were more likely to persist and had higher postsecondary grade point averages. They also earned more college credits. These relationships were true for both the full sample and the CTE sub-sample (though the difference between CTE dual enrollment and non-dual enrollment students in terms of earning a high school diploma was quite small).

*Table 4.* Outcomes for the Florida Sample

| Variables | Florida Sample | All Students | | CTE Students[2] | | |
|---|---|---|---|---|---|---|
| | | Non-DE Students | DE Students[1] | All | Non-DE Students | DE Students[3] |
| HS Diploma | 88.43% | 87.09% | 98.24% | 94.84% | 94.27% | 98.99% |
| PSE enrollment after HS | 53.79% | 50.06% | 80.88% | 57.31% | 54.00% | 81.37% |
| First enrollment at CC | 68.93% | 73.45% | 48.55% | 74.10% | 77.62% | 57.17% |
| First enrollment at SUS | 31.07% | 26.55% | 51.45% | 25.90% | 22.38% | 42.83% |
| Full-time status | 67.10% | 64.99% | 76.62% | 65.73% | 63.94% | 74.36% |
| 1st year GPA | 2.52 (1.03) | 2.40 (1.06) | 2.96 (0.80) | 2.50 (0.97) | 2.41 (0.99) | 2.91 (0.77) |
| 2nd year GPA | 2.48 (1.00) | 2.36 (1.02) | 2.92 (0.78) | 2.46 (0.94) | 2.36 (0.95) | 2.86 (0.75) |
| Total GPA for three years | 2.47 (0.97) | 2.35 (0.99) | 2.91 (0.77) | 2.45 (0.92) | 2.35 (0.75) | 2.84 (0.75) |
| # of credits earned | 45.34 (34.02) | 40.51 (32.08) | 67.10 (34.00) | 44.14 (32.63) | 40.14 (31.13) | 63.42 (32.83) |
| Persistence to 2nd term | 78.71% | 76.83% | 87.18% | 79.27% | 77.71% | 86.80% |
| Persistence to 2nd year | 72.72% | 70.48% | 82.81% | 72.94% | 71.08% | 81.89% |

*Note:* Standard deviations for continuous variables are in parentheses.

[1] DE students are all individuals who took at least one DE course while enrolled in high schools.

[2] CTE students are all individuals who registered for three or more CTE courses.

[3] DE students are among CTE students those who took at least one DE course.

## Short-term Outcomes

Dual enrollment was related to students' likelihood of earning a high school diploma. For the full sample, students who participated in dual enrollment were 4.3 percent more likely than their peers to earn a diploma, a statistically significant difference at a 1 percent level. For CTE students, the effects were also significant, though at the 5 percent level, with CTE students 1 percent more likely than their peers to earn a regular high school diploma. These outcomes are shown in Table 5.

*Table 5.* Logit Regressions of Earning a High School Diploma on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.118*** | 0.054*** | 0.043*** | 0.048*** | 0.016*** | 0.010** |
| | (0.006) | (0.004) | (0.004) | (0.008) | (0.005) | (0.004) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 233,256 | 233,255 | 217,466 | 32,943 | 32,943 | 31,050 |
| Pseudo R-squared | 0.056 | 0.189 | 0.187 | 0.042 | 0.181 | 0.201 |

*Note:* Robust standard errors are in parentheses.

[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.

[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.

* Significant at 10%; ** significant at 5%; *** significant at 1%.

Participation in dual enrollment was also positively related to enrollment in college for both the full sample and for CTE students (Table 6). In the full sample, dual enrollment participants were 16.8 percent more likely to enroll in college than their non-participating peers. For CTE students, the effect was a statistically significant increase of 18.1 percent in the likelihood that they would enroll in college after high school. Dual enrollment participation also increased the likelihood of initially enrolling in a four-year institution, by 7.7 percent for all students and 8.6 percent for CTE students (Table 7).

*Table 6.* Logit Regressions of Postsecondary Enrollment after High School on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.267*** | 0.164*** | 0.168*** | 0.268*** | 0.168*** | 0.181*** |
| | (0.010) | (0.009) | (0.009) | (0.018) | (0.017) | (0.017) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 233,256 | 233,255 | 217,466 | 32,943 | 32,943 | 31,056 |
| Pseudo R-squared | 0.096 | 0.135 | 0.137 | 0.087 | 0.134 | 0.144 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.
[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

*Table 7.* Logit Regressions of University Enrollment in the First Term on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.194*** | 0.037*** | 0.077*** | 0.177*** | 0.058*** | 0.086*** |
| | (0.012) | (0.012) | (0.010) | (0.018) | (0.016) | (0.012) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 132735 | 132734 | 127623 | 19274 | 19274 | 18573 |
| Pseudo R-squared | 0.070 | 0.216 | 0.266 | 0.057 | 0.181 | 0.243 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.
[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8 shows that for students who enrolled in postsecondary education, dual enrollment participation was also positively related to their likelihood of enrolling full-time. For the full sample, dual enrollment students were 4.5 percent more likely than their non-participating peers to enroll in college full-time. CTE dual enrollment students were 4.9 percent more likely to en-

roll in college full-time than their non-participating peers.

*Table 8.* Logit Regressions of Full-time Status in the First Term on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.106*** | 0.037*** | 0.045*** | 0.105*** | 0.042*** | 0.049*** |
| | (0.006) | (0.006) | (0.006) | (0.012) | (0.012) | (0.012) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 132,735 | 132,734 | 127,623 | 19,274 | 19,274 | 18,570 |
| Pseudo R-squared | 0.017 | 0.044 | 0.047 | 0.013 | 0.039 | 0.041 |

*Note:* Robust standard errors are in parentheses.

[1] Demographics include gender, race/ethnicity, cohort year, disability, English limited proficiency, and free/reduced lunch programs.

[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.

* Significant at 10%; ** significant at 5%; *** significant at 1%.

Dual enrollment had the expected positive influence on students' initial persistence in postsecondary education for those students who enrolled in college after high school. Dual enrollment students, whether in the full sample or the CTE sub-sample, were statistically significantly more likely to persist in college to a second semester (Table 9). The effect size for this outcome was 4.5 percent for the full sample and 4.2 percent for the CTE sub-sample; both were significant at the 1 percent level.

Likewise, dual enrollment students' postsecondary grade point averages one year after high school graduation were statistically significantly higher than those of their non-dual enrollment peers. This is shown in Table 10. The difference ranges from as low as 0.21 points for all students to as high as 0.26 points for CTE students only.

*Table 9.* Logit Regressions of Persistence to the Second Term on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.096*** | 0.034*** | 0.045*** | 0.090*** | 0.034*** | 0.042*** |
| | (0.006) | (0.006) | (0.005) | (0.011) | (0.010) | (0.010) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 132,735 | 132,734 | 127,623 | 19,274 | 19,274 | 18,573 |
| Pseudo R-squared | 0.025 | 0.062 | 0.069 | 0.019 | 0.055 | 0.061 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.
[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

*Table 10.* OLS Regressions of First Year Grade Point Average on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.474*** | 0.196*** | 0.215*** | 0.461*** | 0.256*** | 0.262*** |
| | (0.014) | (0.014) | (0.014) | (0.025) | (0.027) | (0.026) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 133,420 | 133,419 | 128,295 | 19,326 | 19,326 | 18,601 |
| R-squared | 0.095 | 0.233 | 0.245 | 0.067 | 0.175 | 0.182 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.
[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

Participation intensity, defined as the number of dual enrollment courses taken, appeared to have little impact on short-term outcomes. The statistically significant effect of dual enrollment participation versus non-participation generally remained the same regardless of whether students took one, two, three or four, or five or more dual enrollment courses. This was true for both the full sample and the CTE sub-sample. Occasionally, the statistical significance of the relationship increased with additional dual enrollment courses, but this was rare, and the direction of the rela-

tionship or its overall significance did not shift. These relationships are shown in Table 11.

There were two exceptions to this. The first was earning a high school diploma; while the positive relationship between dual enrollment participation and earning a diploma remained for the full sample, there was no longer a significant difference for CTE students when intensity was taken into account. Secondly, highly intensive dual enrollment participation (five or more courses) did not result in a statistically increased likelihood of enrolling in a four-year institution as compared to non-participation, for both the full sample and the CTE sub-sample, and for the CTE sub-sample, high levels of participation did not positively influence the likelihood of enrolling full-time or persisting to the second term. However, other participation patterns did remain positively related to these variables. It may be that there is a non-linear relationship between participation intensity and outcomes, with participating in multiple courses being generally beneficial, but that the positive impact of this becomes smaller as more courses are added.

*Table 11*. The Effects of the Number of DE Courses Taken on Short-term Outcomes in Florida

| | All Students | | | | | | CTE Students | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | HS Diploma dy/dx | PSE Enrollment dy/dx | SUS Enrollment dy/dx | Full-time Status dy/dx | 1st Year GPA dy/dx | Persist to 2nd Term dy/dx | HS Diploma dy/dx | PSE Enrollment dy/dx | SUS Enrollment dy/dx | Full-time Status dy/dx | 1st Year GPA dy/dx | Persist to 2nd Term dy/dx |
| 1 DE course | 0.029** | 0.132** | 0.083** | 0.031** | 0.152** | 0.028** | 0.016 | 0.169** | 0.069** | 0.045* | 0.135** | 0.043* |
| | (0.005) | (0.012) | (0.011) | (0.009) | (0.024) | (0.007) | (0.011) | (0.025) | (0.016) | (0.019) | (0.041) | (0.017) |
| 2 DE courses | 0.055** | 0.157** | 0.114** | 0.061** | 0.189** | 0.054** | 0.013 | 0.194** | 0.132** | 0.059** | 0.181** | 0.059** |
| | (0.005) | (0.011) | (0.011) | (0.008) | (0.013) | (0.008) | (0.008) | (0.025) | (0.014) | (0.020) | (0.026) | (0.017) |
| 3-4 DE courses | 0.044** | 0.176** | 0.081** | 0.050** | 0.218** | 0.047** | 0.008 | 0.138** | 0.088** | 0.066** | 0.336** | 0.040* |
| | (0.007) | (0.014) | (0.013) | (0.009) | (0.017) | (0.008) | (0.009) | (0.029) | (0.018) | (0.023) | (0.031) | (0.019) |
| 5+ DE courses | 0.045** | 0.212** | 0.027 | 0.032** | 0.299** | 0.049** | 0.005 | 0.218** | 0.031 | 0.026 | 0.435** | 0.022 |
| | (0.007) | (0.018) | (0.017) | (0.011) | (0.021) | (0.010) | (0.007) | (0.034) | (0.024) | (0.021) | (0.046) | (0.018) |
| Observations | 217,466 | 217,466 | 127,623 | 127,623 | 128,295 | 127,623 | 31,050 | 31,056 | 18,573 | 18,570 | 18,601 | 18,573 |
| Pseudo R-squared | 0.187 | 0.138 | 0.267 | 0.047 | 0.245 | 0.069 | 0.200 | 0.144 | 0.245 | 0.041 | 0.185 | 0.061 |

*Note:* Robust standard errors are in parentheses. All models include demographics (gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs); high school grade point average; and high school characteristics (proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education).
* Significant at 5%; ** significant at 1%.

## Long-term Outcomes

Dual enrollment was also positively related to students' longer-term postsecondary outcomes. Table 12 shows that, among those students who ever enrolled in postsecondary education, dual enrollment participation was positively associated with their likelihood of remaining enrolled two years after graduating from high school. Specifically, for the full sample, dual enrollment students were 5.4 percent more likely than their non-participating peers to be enrolled. CTE students in dual enrollment were 5.2 percent more likely to be enrolled than their CTE peers who did not participate in dual enrollment.

*Table 12.* Logit Regressions of Persistence to the Second Year on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.111*** | 0.039*** | 0.054*** | 0.109*** | 0.039*** | 0.052*** |
| | (0.007) | (0.007) | (0.006) | (0.012) | (0.012) | (0.011) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 132,735 | 132,734 | 127,623 | 19,274 | 19,274 | 18,573 |
| Pseudo R-squared | 0.030 | 0.067 | 0.077 | 0.021 | 0.060 | 0.072 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.
[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

Likewise, dual enrollment students' grade point averages after two years of college were statistically significantly higher than those of their non-participating peers. This relationship held true for both the full sample and the CTE sub-sample (effect sizes of 21.1 and 25.5 percent, respectively). This relationship is shown in Table 13.

*Table 13.* OLS Regressions of Second-Year Grade Point Average on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.469*** | 0.192*** | 0.211*** | 0.455*** | 0.248*** | 0.255*** |
| | (0.014) | (0.013) | (0.013) | (0.025) | (0.027) | (0.025) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 133,420 | 133,419 | 128,295 | 19,326 | 19,326 | 18,601 |
| R-squared | 0.108 | 0.254 | 0.267 | 0.076 | 0.194 | 0.203 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.
[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

The positive relationship between dual enrollment participation and grade point average continued throughout students' postsecondary careers. Dual enrollment students' cumulative college GPA three years after high school graduation was statistically significantly higher than their non-participating peers, for both the full sample and the CTE sub-sample (Table 14). Overall, dual enrollment students had cumulative GPAs 0.20 points higher than those of the comparison group, while for CTE students the statistical difference increased to 0.24 points.

*Table 14.* OLS Regressions of Cumulative Grade Point Average on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 0.462*** | 0.184*** | 0.203*** | 0.444*** | 0.235*** | 0.243*** |
| | (0.013) | (0.013) | (0.012) | (0.024) | (0.027) | (0.024) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 133,420 | 133,419 | 128,295 | 19,326 | 19,326 | 18,601 |
| R-squared | 0.116 | 0.271 | 0.286 | 0.080 | 0.207 | 0.218 |

*Note:* Robust standard errors are in parentheses.

[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.

[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.

* Significant at 10%; ** significant at 5%; *** significant at 1%.

Finally, the Florida data did not cover a long enough time period for us to determine if dual enrollment had an impact on credential attainment. We used the number of credits earned within three years of high school graduation by students who had ever enrolled in postsecondary education as a proxy, since this indicates students' progress toward earning a degree. For this outcome, too, dual enrollment had a statistically significant positive relationship. For the full sample, dual enrollment students had earned 15.1 more credits than their non-dual enrollment peers. CTE dual enrollment students had earned 15.2 more credits than had their non-dual enrollment CTE peers (Table 15). Although some of these credits were likely earned through dual enrollment, it is also likely that some were earned after matriculation into postsecondary education. Regardless, dual enrollment students made more rapid progress toward earning a degree; given that many students now take longer than the traditional two or four years to earn associate or bachelor's degrees, this is an important positive outcome.

*Table 15.* OLS Regressions of Postsecondary Credits Earned within Three Years on DE Participation in Florida

| | All Students | | | CTE Students | | |
|---|---|---|---|---|---|---|
| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx |
| DE participation | 23.791*** | 14.200*** | 15.173*** | 22.487*** | 13.913*** | 15.227*** |
| | (0.684) | (0.625) | (0.482) | (1.099) | (1.031) | (0.875) |
| Demographics[1] | YES | YES | YES | YES | YES | YES |
| HS GPA | NO | YES | YES | NO | YES | YES |
| HS-level variables[2] | NO | NO | YES | NO | NO | YES |
| Observations | 132,735 | 132,734 | 127,623 | 19,274 | 19,274 | 18,573 |
| R-squared | 0.133 | 0.266 | 0.288 | 0.101 | 0.231 | 0.256 |

*Note:* Robust standard errors are in parentheses.

[1] Demographics include gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs.

[2] High school characteristics include proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education.

* Significant at 10%; ** significant at 5%; *** significant at 1%.

As with short-term outcomes, intensity of participation had little association with outcomes, for either the full sample or the CTE sub-sample. For all outcomes, the sign and statistical significance of dual enrollment participation as compared to no participation remained the same no matter how many dual enrollment courses students took (Table 16). In most cases, the effect size differed somewhat by intensity, but the overall significance did not. For example, CTE students who took one and two dual enrollment courses had cumulative grade point averages 0.13 and 0.17 points higher than their non-dual enrollment peers, while CTE students who took three or four, or five or more, dual enrollment courses had grade point averages of 0.32 and 0.39 points higher, respectively. All of these effect sizes, however, were significant at the 1 percent level.

*Table 16.* The Effects of the Number of DE Courses Taken on Long-term Outcomes in Florida

| | All Students | | | | CTE Students | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | 2nd year GPA dy/dx | Cumulative GPA dy/dx | Persist to 2nd Year dy/dx | PSE Credits Earned dy/dx | 2nd year GPA dy/dx | Cumulative GPA dy/dx | Persist to 2nd Year dy/dx | PSE Credits Earned dy/dx |
| 1 DE course | 0.159** | 0.158** | 0.032** | 7.394** | 0.130** | 0.129** | 0.080** | 7.862** |
| | (0.020) | (0.018) | (0.008) | (0.645) | (0.039) | (0.035) | (0.020) | (1.198) |
| 2 DE courses | 0.185** | 0.177** | 0.066** | 11.967** | 0.182** | 0.178** | 0.058** | 12.430** |
| | (0.013) | (0.013) | (0.008) | (0.594) | (0.025) | (0.027) | (0.018) | (1.263) |
| 3-4 DE courses | 0.215** | 0.209** | 0.057** | 14.941** | 0.335** | 0.316** | 0.058** | 16.860** |
| | (0.016) | (0.016) | (0.010) | (0.670) | (0.029) | (0.029) | (0.021) | (1.477) |
| 5+ DE courses | 0.285** | 0.270** | 0.059** | 25.655** | 0.413** | 0.390** | 0.016 | 25.498** |
| | (0.019) | (0.018) | (0.010) | (0.838) | (0.044) | (0.044) | (0.020) | (1.464) |
| Observations | 128,295 | 128,295 | 127,623 | 127,623 | 18,601 | 18,601 | 18,573 | 18,573 |
| Pseudo R-squared | 0.268 | 0.286 | 0.078 | 0.295 | 0.206 | 0.220 | 0.072 | 0.263 |

*Note:* Robust standard errors are in parentheses. All models include demographics (gender, race/ethnicity, cohort year, disability, limited English proficiency, and free/reduced lunch programs); high school grade point average; and high school characteristics (proportions of black and Hispanic students, charter school, school grade, location, pupil-to-teacher ratio, median household income of residents, and proportion of residents with college or higher education). * Significant at 5%; ** significant at 1%.

## Conclusions—Florida

The Florida data analyses explored the outcomes of dual enrollment participation for (1) all students in the state and (2) a sub-sample of CTE students. They enabled us to look at short- and long-term outcomes, including high school graduation and initial experiences in postsecondary education. The findings show a positive relationship between dual enrollment participation and educational outcomes.

Dual enrollment participation had a statistically significant positive association with students' likelihood of earning a regular high school diploma and enrolling in postsecondary education. For those students who did enroll in college, dual enrollment participation was also positively related to their likelihood of enrolling full-time, first-term grade point averages, and persistence to a second term of college. Dual enrollment participation also had a statistically significant positive relationship to all longer-term outcomes explored in the analyses, including second-year and final grade point averages, persistence to the second year of college, and total postsecondary credits earned.

All of these findings held true for both the full sample and the CTE sub-sample, indicating that CTE students are likely to benefit from dual enrollment participation in the same ways as their non-CTE peers do. There was not, however, an intensity effect for dual enrollment partici-

pation. The impact of participation remained the same in terms of the direction of the coefficient and the strength of significance regardless of whether students took one, two, three or four, or five or more dual enrollment courses.

The positive results presented in this section are very encouraging, though not definitive, and appear to indicate that dual enrollment has a strong potential for improving students' postsecondary outcomes. However, readers should interpret these results with caution. Although we attempted to control for students' preexisting characteristics, including academic achievement and socioeconomic background, our measures were imperfect. The measure for academic achievement—high school grade point average—was somewhat endogenous with dual enrollment participation. Our socioeconomic measures were derived from school-level rather than student-level data, and thus may not fully reflect students' backgrounds. Thus, the positive results may derive from unmeasured differences between dual enrollment students and their non-dual enrollment peers rather than from any program impact. In other words, by including only imperfect measures of important factors affecting a student's decision to participate in dual enrollment, it is possible that our models may generate what appear to be positive impacts when in fact there are no such impacts or there are negative impacts. Future analyses should seek stronger measures of academic and socioeconomic characteristics in order to minimize this problem.

## FINDINGS: NEW YORK CITY

New York City's public university system, the City University of New York (CUNY), has a long-standing dual enrollment program, College Now. The program started at Kingsborough Community College in the 1980s and expanded to other institutions during the 1990s. In 1999, the New York City Department of Education and CUNY collaborated in an effort to institutionalize the program throughout the city (Kleiman, 2001; "Partnership for Student Achievement," n.d). By the 2002-03 school year, many New York City high schools and every two- and four-year college in the CUNY system participated in College Now.

Moreover, the two systems have sought to work more closely with each other on issues involving dual enrollment around the city. Though there is some programmatic variation from school to school and campus to campus, programs are more similar in New York than in many other locations. All students adhere to the same program selection criteria and application processes; the standards for dual enrollment courses (in terms of curriculum and instructional experiences) are similar as well. The program is coordinated through a central office located within CUNY's Office of Academic Affairs. This office also engages in data collection and program evaluation.

Unlike other dual enrollment programs, the goals of College Now extend beyond offering college courses to high school students. The program explicitly aims to prepare all New York City high school students for college, and thus offers an array of activities intended to increase students' academic skills. These include traditional dual enrollment college credit courses, but also remedial or developmental courses and enrichment activities. Students who do not meet the eligibility criteria for college courses may enroll in remedial courses; as with other forms of dual enrollment, these courses are similar to the remedial courses offered to undergraduates on college campuses, often using the same syllabi and textbooks. They do not, however, lead to college credit since they are at a pre-college level. Ideally, participation in remediation during high school should lead to placement in regular college courses upon postsecondary matriculation. Students may also enroll in high school credit courses offered jointly with CUNY that aim to strengthen literacy skills and participate in a variety of other activities aimed at increasing students' skills and motivation to attend college. College Now has also recently begun to develop "Foundation Courses," which are intended to prepare 10$^{th}$ and 11$^{th}$ grade students for the academic demands of college through pre-college courses focused on learning in the disciplines.

Most College Now courses are offered at the high school and taught by high school teachers certified as college adjuncts. However, some students may be given the opportunity to take college courses on a college campus with regularly matriculated college students. CUNY colleges oversee the high school adjunct faculty, approving their syllabi and observing their teaching in order to ensure that courses are taught at an appropriate level.

### CUNY Dataset

The data collected from College Now come from two sources—the College Now central

office and CUNY's Office of Institutional Research. The College Now central office collects data on all students participating in the College Now program, including demographic information, the courses taken by students and whether they were college-level or developmental, and grades earned. These data were available for all students attending the 19 vocational high schools in New York City.

The data from the institutional research office contain a record for every student in each entering university cohort and are updated annually. The data include all information collected during the university application process, including demographics and information on students' high school academic performance. They also include students' semester-by-semester enrollment (credits attempted and earned) and grades in all courses taken throughout the CUNY system.

Our dataset from the CUNY Office of Institutional Research included all students enrolling in a CUNY college in 2001 and 2002. Linking this with the College Now office data enabled us to create a dataset including all students who graduated from a vocational high school and enrolled in CUNY for the first time in 2001 or 2002. The sample included 2,303 records. The dataset included information on whether or not students participated in College Now, their enrollment patterns, and their progress toward a degree over the first three-and-a-half years of enrollment.

Although the dataset contained a rich array of control and outcomes variables, it did have some shortcomings. First, it was not representative of the entire College Now or CUNY population, so results should be interpreted carefully. They are relevant only for those students who entered high school with an orientation toward career and technical education. More importantly, the sample was limited to those students who matriculated into the CUNY system. Therefore, graduates of the 19 high schools who did not enroll in college, as well as those who enrolled in private colleges or public colleges outside of New York City, are not included in the sample. Finally, because the sample is relatively small, we were unable to disaggregate by high school or type of College Now experience.

### Variables Included in the Analyses

The analyses examined the impact of participation in College Now on subsequent matriculation into and persistence in CUNY for CTE students. *Participation* was defined as completing a College Now course, either for-credit or remedial. Students who enrolled but then withdrew from their dual enrollment course were not considered participants, as it was impossible to ascertain the extent to which they participated in the program (i.e., whether they dropped after one course session or multiple sessions.) *CTE students* were defined as those students enrolled in a vocational high school in New York City, as previously described.

We examined the potential impact of participation on a variety of outcomes. Outcomes variables included the following:

*Degree pursued:* This variable indicated whether students were pursuing an associate or a

bachelor's degree. This variable was taken from students' postsecondary records, which indicate the type of degree program in which they enrolled during their first term.

*Full-time student:* This variable indicated whether the students enrolled full- or part-time during their first semester of enrollment. Full-time enrollment was defined as registering for 12 or more credits.

*First-term grade point average (GPA):* This variable, calculated by the CUNY Office of Institutional Research, reflects students' academic achievement during their first semester of postsecondary enrollment.

*Fourth-term GPA:* This variable, calculated by the CUNY Office of Institutional Research, reflects students' academic achievement two full years after their initial enrollment in postsecondary education. For students who dropped out of college before two years of enrollment, their GPA for their last semester of enrollment was used.

*Persistence to second term:* This variable was a dichotomous variable indicating whether students reenrolled in postsecondary education after their initial semester in college.

*Persistence to second year:* This variable was a dichotomous variable indicating whether students reenrolled in postsecondary education for a second year. It was possible for an individual student to persist to the second year without persisting to the second term.

*Number of credits earned after three-and-a-half years:* The dataset did not follow students for enough time to determine bachelor's degree attainment, so this variable served as a proxy for progress toward a degree. It indicates the number of postsecondary credits students had earned three-and-a-half years after their initial enrollment in CUNY.

The analyses included an array of control variables in order to isolate the effect of College Now participation from the confounding effects associated with relevant preexisting differences between the groups. As discussed above, the first model included only variables for participation and cohort. The second model added student demographic variables: gender, race, and age at application to CUNY, all of which were generated by the CUNY Office of Institutional Research. In the third model, we added students' high school achievement as measured by the College Admissions Average. This is a composite variable, created by the CUNY admissions office, measuring student achievement in academic college preparatory courses such as math, English, social studies/history, and science courses. Most of the courses included in this average pre-dated student enrollment in College Now; however, readers are cautioned that the potential endogeneity of this variable may hide some effects of program participation.

The fourth model adds in two controls for student socioeconomic background: the median household income and the percentage of residents with a college degree in their zip code of residence during high school. Both variables were generated using student zip code informa-

tion from CUNY. By matching student zip code to 2000 Census data, we were able to obtain socioeconomic data for their home neighborhoods. It is important to note that these variables are somewhat imprecise, as they focus on aggregate measures of socioeconomic status rather than measures linked to individual students.

The final model adds in school-level controls in order to account for differences in students' pre-collegiate academic experiences. These variables include the percentage of black and Hispanic students, the percentage of students receiving free or reduced lunch, and the average class size for each high school. These variables were generated using the U.S. Department of Education's Common Core of Data.

We ran each regression for the entire sample, comparing students with any degree of participation in College Now to their peers with no participation. Then, as with Florida, we conducted a second set of analyses that accounted for students' participation intensity. Because the sample was smaller than the Florida sample, we could examine only whether students participated in one College Now course or two or more courses (leaving no participation as the reference). The models for these analyses included the outcomes and control variables described above.

**Descriptive Statistics**

Prior to running the outcomes analyses, we explored the demographic characteristics of our sample. Table 17 presents these findings, both for the entire sample and disaggregated by College Now participation. College Now students were more likely than non-participants to be female, black, or Asian. They also had higher CUNY College Admissions Averages. They were less likely to be white or Hispanic. Both groups of participants came from neighborhoods with similar household incomes and education levels.

*Table 17.* Demographic Characteristics of the CUNY Sample

| Variables | All students | Sub-samples | |
|---|---|---|---|
| | | Non-participant | Participants |
| *Demographics* | | | |
| Female | 52.32% | 51.41% | 58.20% |
| White | 3.56% | 3.80% | 2.05% |
| Black | 42.54% | 40.18% | 57.34% |
| Hispanic | 42.54% | 45.50% | 23.89% |
| Asian | 5.38% | 5.04% | 7.51% |
| Other | 5.99% | 5.48% | 9.22% |
| Age | 19.33 | 19.49 | 18.31 |
| College admissions average | 75.01 (6.64) | 74.46 (6.50) | 78.31 (6.54) |
| Median household income | $32,310 (11,059) | $32,240 (11,175) | $32,758 (10,287) |
| Percentage of residents with college education | 16.55 (9.83) | 16.54 (9.90) | 16.56 (9.42) |
| Observations | 2,303 | 1,992 | 311 |
| Percentages over total | 100% | 86.50% | 13.50% |

*Note:* Standard deviations for continuous variables are reported in parenthesis.

It should be noted that our sample, focused as it was on CTE students, differed demographically from the broader College Now population. According to internal analyses conducted by the CUNY Office of Academic Affairs, 60 percent of associate degree and 65 percent of bachelor's degree students who participated in College Now and entered a CUNY institution in 2002 were female, higher than the percentage of female students in our sample. Likewise, our sample had a higher percentage of black students and a lower percentage of white students. The College Admissions Average of the College Now CTE students (78.31) was higher than that of all College Now participants entering associate degree programs (74.5) but lower than that of College Now participants entering bachelor's degree programs (82.3). Thus, it is important not to generalize the findings presented in this section to College Now generally, as they pertain only to students entering CUNY from the 19 vocational high schools, who may differ from other New York City students in a variety of ways.

Table 18 illustrates that most College Now students participated in one course rather than multiple courses. Given the small size of the sample, we could include in our models only whether students took one course or two or more courses. Most students participated in only one course, which is a different participation pattern than that observed in the Florida dataset.

*Table 18.* Number of College Now Courses Taken by Students in the CUNY Sample

| Number of College Now courses | Observations | Percentage |
|---|---|---|
| None | 1,992 | 86.5% |
| 1 | 201 | 8.7% |
| 2 + | 110 | 4.8% |
| Sub total (participants) | 311 | 13.5% |
| Total | 2,303 | 100% |

Given that the sample was limited to those who enrolled in the City University of New York, we were particularly interested in whether our sample was representative of their high school populations. Table 19 illustrates that the sample differs from the general student population in the 19 schools with regard to the percentage of female and white students, but is relatively similar in terms of the percentage of black, Hispanic, and Asian students. It is unclear why the CUNY sample has such a high proportion of women compared to the CTE high school population.

*Table 19.* Characteristics of CUNY Sample Compared to the New York City CTE Population

| Demographics | NYC CTE Schools[1] | CUNY Sample |
|---|---|---|
| Percentage of Female students | 38.65% | 52.32% |
| Percentage of White students | 5.99% | 3.56% |
| Percentage of Black students | 45.05% | 42.54% |
| Percentage of Hispanic students | 42.80% | 42.54% |
| Percentage of Asian students | 5.85% | 5.38% |
| Percentage of Other students | 0.31% | 5.99% |
| Observations | 55,634 | 2,303 |

[1] Data taken from Common Core of Data.

Prior to controlling for preexisting characteristics, did College Now participants and their non-participating peers differ in their postsecondary outcomes? Student outcomes did vary by participation status, as shown in Table 20. College Now participants were more likely than their non-participating peers to pursue a bachelor's degree and persist to the second year of college. They also had higher grade point averages after both the first and fourth semesters of college enrollment and had earned more credits four years after postsecondary enrollment.

*Table 20.* Outcomes for the CUNY Sample

| Variables | All students | Sub-samples | |
|---|---|---|---|
| | | Non-participant | All participants |
| *Educational Outcomes* | | | |
| A bachelor's degree pursued | 31.02% | 27.79% | 52.35% |
| Full-time status in the 1st term | 91.12% | 90.04% | 94.30% |
| GPA for the 1st term | 2.31 (1.02) | 2.28 (1.03) | 2.53 (0.92) |
| GPA for the 4th term | 2.19 (0.83) | 2.16 (0.84) | 2.37 (0.77) |
| Persistence to the 2nd term | 84.46% | 84.19% | 86.17% |
| Persistence to the 2nd year | 61.88% | 60.64% | 69.77% |
| Number of credits earned for 3.5 years | 50.17 (41.21) | 47.36 (40.40) | 68.17 (41.91) |
| Observations | 2,303 | 1,992 | 311 |
| Percentages over total | 100% | 86.50% | 13.50% |

*Note:* Standard deviations for continuous variables are reported in parenthesis.

## Short-term Outcomes

In examining the short-term outcomes for CTE students in New York City, we found generally positive results. First, for the most comprehensive model, College Now participants were 9.7 percent more likely than their peers to pursue a bachelor's degree (as opposed to an associate degree), a strong, statistically significant difference, as shown in Table 21 (Model 4). This is a particularly interesting finding given that all students in the sample were enrolled in CTE high school programs. Studies of other CTE programs, such as Tech Prep, have found that participants in such programs were less likely to pursue a bachelor's degree than non-participants (Bragg, 2001). It seems from these results that College Now may actually increase students' aspirations.

*Table 21.* Logit Regression of College Now Course Participation on Pursuing a Bachelor's Degree in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 0.186*** | 0.101*** | 0.099*** | 0.097*** |
| | (0.027) | (0.034) | (0.032) | (0.029) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 2,101 | 1,964 | 1,960 | 1,960 |
| Pseudo R-squared | 0.074 | 0.217 | 0.219 | 0.226 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, and age.
[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.
[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 22 shows that College Now participation was also positively related to students' first-semester grade point averages. The association was strong for our baseline model with demographic controls, but became only weakly statistically significant at the 10 percent level when we included the measure of student ability. For model 4 we found that College Now participants had first-term grade point averages 0.133 points higher than those of non-participants.

*Table 22.* OLS Regression of College Now Course Participation on the First-Term GPA in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 0.270*** | 0.128* | 0.128* | 0.133* |
| | (0.074) | (0.063) | (0.068) | (0.066) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 1,804 | 1,706 | 1,703 | 1,703 |
| R-squared | 0.042 | 0.115 | 0.121 | 0.127 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, and age.
[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.
[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

However, as Table 23 illustrates, CTE College Now students' stronger academic performance during their first semester did not translate into an increased likelihood of persistence. There was no statistically significant relationship between College Now participation and persistence to the second semester of college.

*Table 23.* Logit Regression of College Now Course Participation on Persistence to the Second Term in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 0.024 | 0.009 | 0.007 | 0.010 |
| | (0.022) | (0.020) | (0.020) | (0.020) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 2,136 | 1,998 | 1,994 | 1,994 |
| Pseudo R-squared | 0.023 | 0.022 | 0.023 | 0.025 |

*Note:* Robust standard errors are in parentheses.

[1] Demographics include gender, race/ethnicity, cohort year, and age.

[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.

[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.

* Significant at 10%; ** significant at 5%; *** significant at 1%.

Likewise, participation had no statistically significant association with enrolling in college full-time, as shown in Table 24. This may be due to CTE students' ability to find well-paying jobs (thus limiting the appeal of enrolling full-time) or to the fact that financial needs may override any motivation to enroll full-time stemming from College Now participation.

*Table 24.* Logit Regression of College Now Course Participation on Being a Full-time Student in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 0.026 | 0.013 | 0.012 | 0.015 |
| | (0.017) | (0.016) | (0.016) | (0.017) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 2,101 | 1,964 | 1,960 | 1,960 |
| Pseudo R-squared | 0.052 | 0.064 | 0.068 | 0.071 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, and age.
[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.
[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

When we added in variables measuring participation intensity, we found similar results, although there does appear to be an intensity effect on some outcomes, in which students benefit from participating in more than one College Now course. This result differs from the Florida data. Specifically, the positive relationship between College Now participation and first semester GPA seems to reflect the impact of taking two or more courses rather than on participation more generally. The intensity impacts for short-term outcomes are shown in Table 25.

*Table 25.* The Effects of the Number of College Now Courses Taken on Short-term Outcomes in CUNY

| Variables | BA degree dy/dx | Full-time dy/dx | 1st term GPA dy/dx | Persist to 2nd term dy/dx |
|---|---|---|---|---|
| Number of College Now courses = 1 | 0.095*** | 0.006 | 0.099 | 0.021 |
| | (0.036) | (0.023) | (0.095) | (0.027) |
| Number of College Now courses ≥ 2 | 0.101*** | 0.035* | 0.198*** | -0.009 |
| | (0.038) | (0.020) | (0.062) | (0.020) |
| Observations | 1,960 | 1,960 | 1,703 | 1,994 |
| Pseudo R-squared | 0.226 | 0.072 | 0.128 | 0.026 |

*Note:* Robust standard errors are in parentheses. All models include demographics (gender, race/ethnicity, cohort year, and age); College Admissions Average; socioeconomic status (median household income of residents and proportion of residents with college or higher education); and high school-level variables (proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio).
* Significant at 10%; ** significant at 5%; *** significant at 1%.

CTE students who took only one College Now course did not differ significantly in their first-semester grades from students who did not participate at all. The previous positive results in Table 22, however, were driven by those students who took two or more courses. We found a statistical difference at a 1 percent level that College Now participants had almost 20 percent higher grade point averages than non-participants, holding everything else constant to their means. Additionally, although College Now participation by itself did not influence student full-time enrollment, there was an intensity effect for this outcome. CTE students who took two or more College Now courses were 3.5 percent more likely to enroll full-time than non-participants (a statistically significant difference), whereas students who took only one course were not more likely to do so.

Intensity was not important across the board, however. All CTE College Now participants, no matter how many courses they took, were more likely than non-participants to enroll in a bachelor's degree program, and College Now was not related to persistence to the second semester, regardless of how many College Now courses students participated in.

**Long-term Outcomes**

College Now was also positively related to some longer-term postsecondary outcomes. As with the short-term outcomes, not all analyses were statistically significantly positive, but none were negative, either. Although estimated coefficients are consistently positive, College Now participation was not statistically significantly related to students' persistence to a second year of college, once high school achievement was controlled for, as shown in Table 26. This finding differs from that of internal analyses of College Now outcomes conducted by CUNY, which found that, for all College Now students, College Now participation did influence persistence to the second year (Michalowski, 2006; Skadberg, 2005). Similarly, the relationship between participation and grade point average after four semesters of enrollment is not statistically different from zero, as shown in Table 27. This differs from our findings in Florida, where dual enrollment was related to higher grade point averages two years after high school graduation.

*Table 26.* Logit Regression of College Now Course Participation on Persistence to the Second Year in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 0.101*** | 0.054 | 0.050 | 0.049 |
| | (0.037) | (0.039) | (0.039) | (0.039) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 2,136 | 1,998 | 1,994 | 1,994 |
| Pseudo R-squared | 0.020 | 0.042 | 0.042 | 0.043 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, and age.
[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.
[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

*Table 27.* OLS Regression of College Now Course Participation on the Fourth-Term GPA in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 0.203*** | 0.033 | 0.033 | 0.026 |
| | (0.038) | (0.044) | (0.043) | (0.044) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 1,933 | 1,821 | 1,818 | 1,818 |
| R-squared | 0.035 | 0.146 | 0.148 | 0.153 |

*Note:* Robust standard errors are in parentheses.
[1] Demographics include gender, race/ethnicity, cohort year, and age.
[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.
[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

However, College Now did appear to be related to CTE students' overall progress toward a degree. Three-and-a-half years after their initial enrollment in postsecondary education, College Now participants had earned significantly more college credits than their non-participating peers. For our baseline model, we found that College Now participants earned 20 more credits than non-participants, but the impact was reduced to a 10-credit difference once we included

high school achievement in Model 2. Still, this relationship remained strong even after controlling for socioeconomic status and school-level characteristics (Table 28). One possible explanation is that College Now students entered college better prepared to take college-level courses (rather than remedial courses that do not lead to credit accrual). Thus, even though participants and non-participants remained enrolled at similar rates, the participants who continued their educations were better able to take courses that actually yielded credit toward a degree.

*Table 28.* OLS Regression of College Now Course Participation on the Number of Credits Earned after Three-and-a-Half Years in CUNY

| Variables | Model 1 dy/dx | Model 2 dy/dx | Model 3 dy/dx | Model 4 dy/dx |
|---|---|---|---|---|
| College Now Participation (=1) | 20.451*** | 10.956*** | 10.856*** | 10.648*** |
| | (2.707) | (3.620) | (3.484) | (3.649) |
| Demographics[1] | YES | YES | YES | YES |
| College Admissions Average | NO | YES | YES | YES |
| Socioeconomic status[2] | NO | NO | YES | YES |
| HS-level variables[3] | NO | NO | NO | YES |
| Observations | 2,136 | 1,998 | 1,994 | 1,994 |
| R-squared | 0.093 | 0.212 | 0.215 | 0.222 |

*Note:* Robust standard errors are in parentheses.

[1] Demographics include gender, race/ethnicity, cohort year, and age.

[2] Socioeconomic status variables include median household income of residents and proportion of residents with college or higher education.

[3] High school characteristics include proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio.

* Significant at 10%; ** significant at 5%; *** significant at 1%.

As with short-term outcomes, there was also an intensity effect, with participating in more College Now courses associated with positive outcomes. In fact, intensity of participation appears to be more important for long- than short-term outcomes. All three long-term outcomes variables were positively related to College Now participation, once intensity was taken into account. These relationships are shown in Table 29.

Interestingly, participating in fewer College Now courses was positively associated with persisting to the second year of postsecondary education. CTE students taking one College Now course were 6.6 percent more likely than their peers taking no courses to persist to the second year of college, whereas students taking two or more courses did not differ significantly from those students taking no courses. This is contrary to all of our other findings, as well as to the hypothesis that additional exposure to college courses would increase students' college readiness and persistence. Nevertheless, it should be pointed out that the estimated effect is also positive for taking two or more College Now courses, and that large standard errors may be due to low statistical power and small sample size.

In contrast, participating in two or more College Now courses is associated with statistically significantly higher grade point averages after four semesters, whereas participating in only one course does not have a statistically significant effect. These results show that previous estimates in Table 27 (no statistically significant effect) mask fundamental variation due to participation intensity. Those CTE students who participated in two or more College Now courses had grade point averages 0.14 points higher than those of their non-participating peers after four semesters. Given that participation more generally was not found to have an effect, the fact that increased participation intensity can encourage positive outcomes is interesting.

Finally, the statistically significant relationship between College Now participation and overall progress toward a degree remains strong after intensity is accounted for. Although participation in both one and two or more College Now courses is associated with more credits accrued three-and-a-half years after enrollment, as compared to no participation, the effect is stronger for students who participated in two or more courses. Those who participated in College Now earned 14 more credits after three-and-a-half years than the comparison group.

*Table 29.* The Effects of the Number of College Now Courses Taken on Long-term Outcomes in CUNY

| Variables | 4th term GPA dy/dx | Persist to 2nd Year dy/dx | Total Credits Earned dy/dx |
|---|---|---|---|
| Number of College Now courses =1 | -0.035 | 0.066* | 8.807** |
| | (0.062) | (0.038) | (3.853) |
| Number of College Now courses ≥ 2 | 0.144* | 0.016 | 14.204** |
| | (0.071) | (0.056) | (5.742) |
| Observations | 1,818 | 1,994 | 1,994 |
| Pseudo R-squared | 0.154 | 0.044 | 0.222 |

*Note:* Robust standard errors are in parentheses. All models include demographics (gender, race/ethnicity, cohort year, and age); College Admissions Average; socioeconomic status (median household income of residents and proportion of residents with college or higher education); and high school-level variables (proportions of black, Hispanic, and free/reduced lunch students, and pupil-to-teacher ratio).
* Significant at 10%; ** significant at 5%; *** significant at 1%.

## Conclusions—New York City

The New York City data explored only the impact of dual enrollment participation for career and technical education students. We found some positive impacts on both short- and long-term outcomes after controlling for student demographics and prior achievement and high school characteristics. In particular, CTE students who participated in College Now were more likely than their non-participating peers to pursue a bachelor's degree. They had higher grade point averages after their first semester in college and had accrued more credits three-and-a-half years after their initial enrollment in postsecondary education. For outcomes with no significant effects, it is important to note that College Now participants had no worse outcomes than their non-participating peers. In other words, though College Now did not always increase student

success, it did not inhibit it, either. Furthermore, some positive effects held even after controlling for high school achievement and socioeconomic background.

The intensity of College Now course-taking was also related to short- and long-term outcomes for College Now participants. The effect on first-term grade point average appears to reflect the positive impact of taking two or more College Now courses rather than to participating in College Now generally. And although College Now participation in any form was not related to full-time enrollment, participating in two or more College Now courses was positively related. A similar relationship exists for students' fourth-term grade point average. College Now was associated with higher rates of credit accrual after three-and-a-half years for all participants, but the effect was stronger for students participating in two or more courses than for students participating in only one course. However, an opposite intensity effect was seen for students' fourth-semester GPAs; students participating in one course had higher grade point averages, while there was no effect on GPA for students participating in two or more courses.

Thus, it appears that dual enrollment participation may lead to positive postsecondary outcomes for CTE students. It is important to remember, however, that this dataset is limited in its generalizability. The controls are also imperfect, as the College Admissions Average is not a full measure of students' preexisting academic achievement and the socioeconomic status variables are drawn from the population of students' zip codes rather than their individual families. Thus, by including only imperfect measures of these important factors affecting the decision to participate in dual enrollment, it is possible that our models may not account for all preexisting differences between dual enrollment students and their non-dual enrollment peers. Nonetheless, these findings are encouraging.

## FINDINGS: OUTCOMES FOR SUB-GROUPS

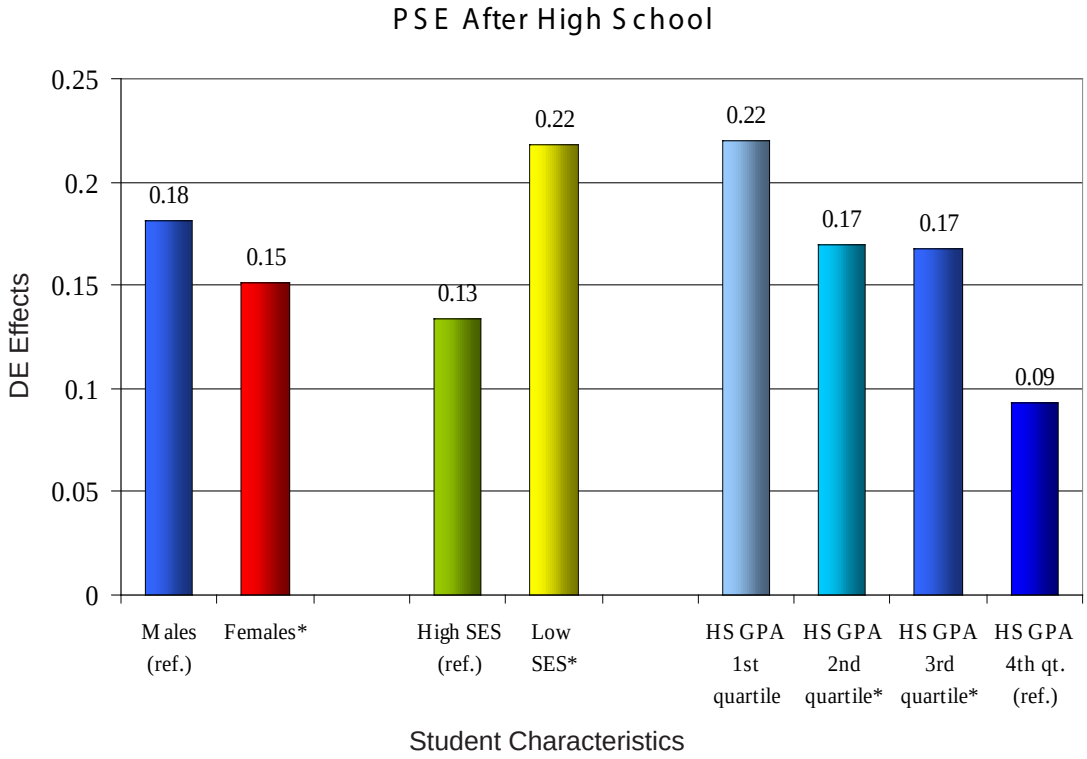
Part of the argument for expanding access to dual enrollment programs rests on an assumption that some types of students, particularly low-income or low-achieving students, may benefit from early exposure to the demands of a college course. This argument is based on evidence that such groups typically have less positive postsecondary outcomes than their more advantaged peers and on a desire to help eliminate these gaps in college achievement. Thus, we examined whether the positive findings found in the analyses of New York and Florida data were particularly strong for certain sub-groups of students. Does dual enrollment participation benefit some groups of students more than others? And if so, are these students the ones who often struggle most to attain postsecondary credentials?

In analyzing differential outcomes for various sub-groups, we conducted a range of analyses looking at a sub-set of the outcome variables discussed in the previous sections. We ran separate regressions of the impact of dual enrollment for each group, and then tested the null hypothesis of equal marginal effects using a standard *t*-test at conventional 5 percent levels. Statistical differences in effects can be treated as differences gained from dual enrollment participation for the various sub-groups. Our analyses focused on differences in gender (since males are increasingly underrepresented in higher education), high school achievement, and socioeconomic status.

Given the size of our New York City sample, we were limited in the analyses we could conduct, since disaggregating the data too much led to very small cell sizes and low statistical power. We were only able to examine differences in outcomes in terms of gender. We found no significant differences between males and females on any of the short-term outcomes included in the New York City analyses (attending a four-year institution; first-semester grade point average; persistence to second semester; persistence to fourth semester). Because College Now participation had a strong influence on the longer-term outcome of total credits earned within three years, we also examined whether there was a differential impact for males or females on this variable. There was not.

Because the Florida dataset was larger, we were able to run analyses for all of the sub-groups. We found that, in many cases, male and low-income students benefited more from dual enrollment participation than their more advantaged peers. Figures 1a and 1b show that the relationship between dual enrollment and students' likelihood of enrolling in any form of postsecondary education after high school graduation differed for various sub-groups, for both the full sample and for the CTE sub-sample. Among the full sample, male participants were significantly more likely than female participants to enroll in college. Likewise, high-SES participants were significantly less likely to enroll in college as compared to the low-SES participants. The CTE sub-sample showed similar results, although the difference between males and females was stronger for this sub-group.

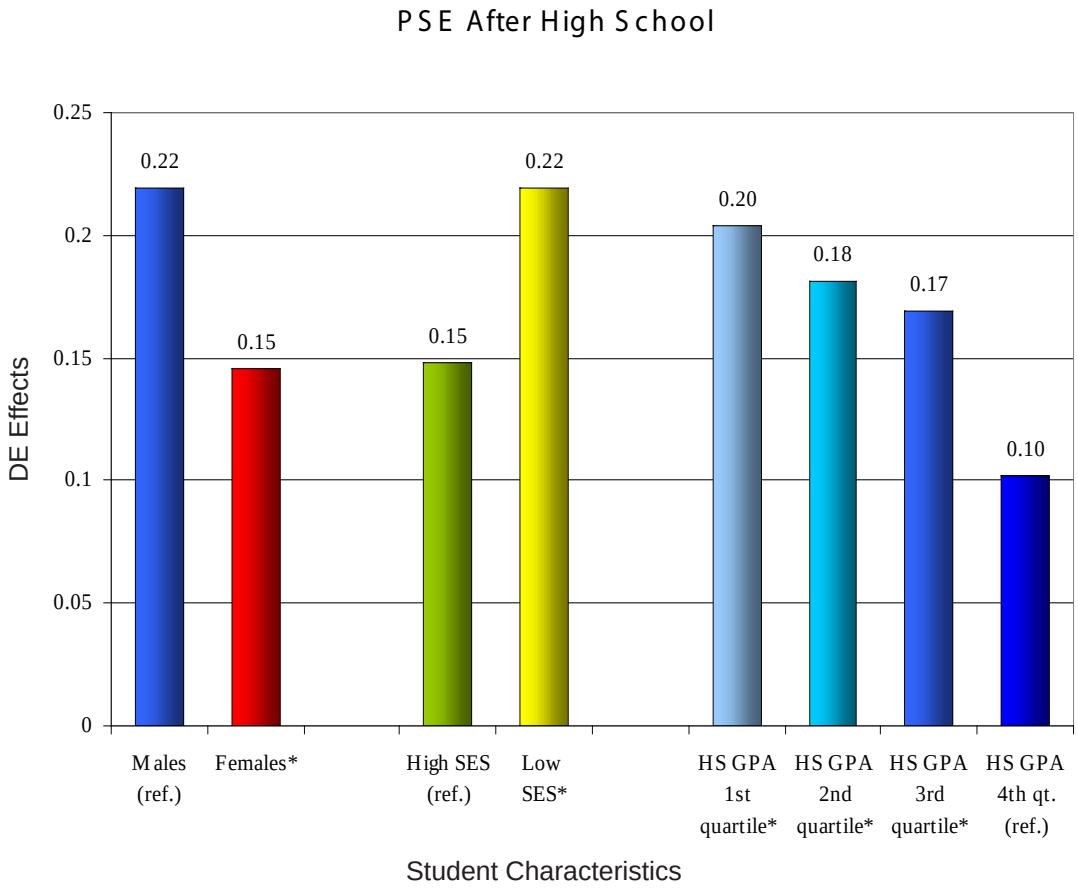
*Figure 1a.* Varied Effects of Dual Enrollment Programs on Postsecondary Education (PSE) Enrollment After High School Among all Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year; disability; Limited English Proficiency (LEP); proportions of black, Hispanic, and free/reduced lunch students; charter school; school grade; median household income of residents; proportion of residents with college or higher education; and location.

* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

*Figure 1b.* Varied Effects of Dual Enrollment Programs on Postsecondary Education (PSE) Enrollment After High School Among CTE Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year; disability; Limited English Proficiency (LEP); proportions of black, Hispanic, and free/reduced lunch students; charter school; school grade; median household income of residents; proportion of residents with college or higher education; and location.

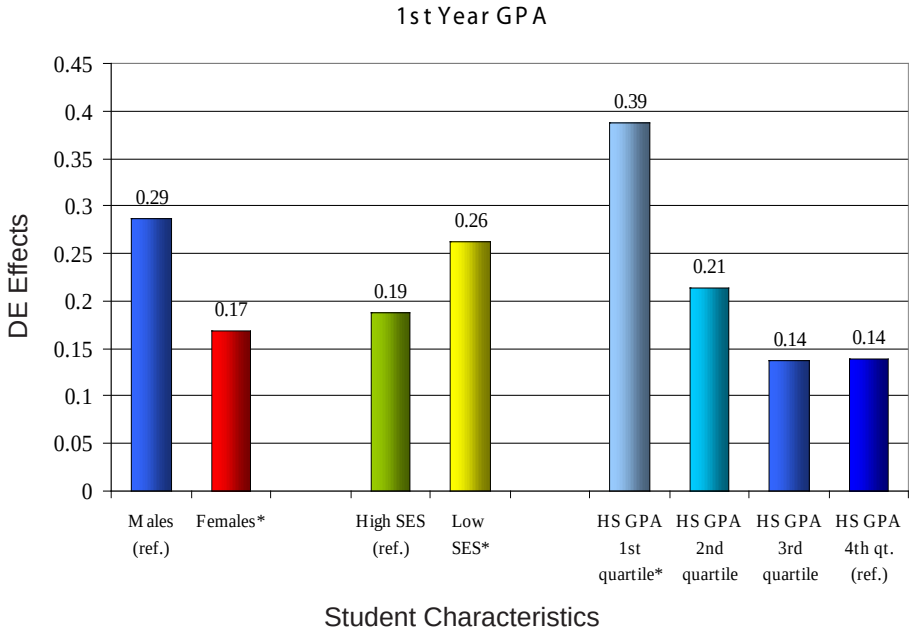
* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

These differences did not remain when we examined dual enrollment students' likelihood of enrolling a four-year rather than a two-year institution, however. There was no gender difference in state university system enrollment rates, and high-SES students were statistically significantly more likely than low-SES students to enroll in a university (not shown). This was true for both the full sample and the CTE sub-sample.

Sub-group differences were also found with regard to students' first-year grade point averages, as shown in Figure 2a. The relationship between participation and grade point average was statistically significantly less for females than for males. It was also statistically significantly greater for students from low socioeconomic statuses than for their more economically advantaged peers. And students in the first quartile of high school grade point averages—those with the lowest high school grades—benefited more strongly in terms of their first-year college grade point averages than the reference group of the highest high school achievers.[6] For CTE students, most of these differences disappeared. However, the gender difference remained, with male CTE students benefiting more from dual enrollment than their female classmates (Figure 2b).

6 It is important to remember that, although there are GPA eligibility restrictions for dual enrollment in Florida, we have shown variation in all quartiles in Table 3 and more than 1,000 students in the lower quartile. Moreover, we used students' final high school grade point averages in the analysis and not their actual academic achievement prior to dual enrollment participation.

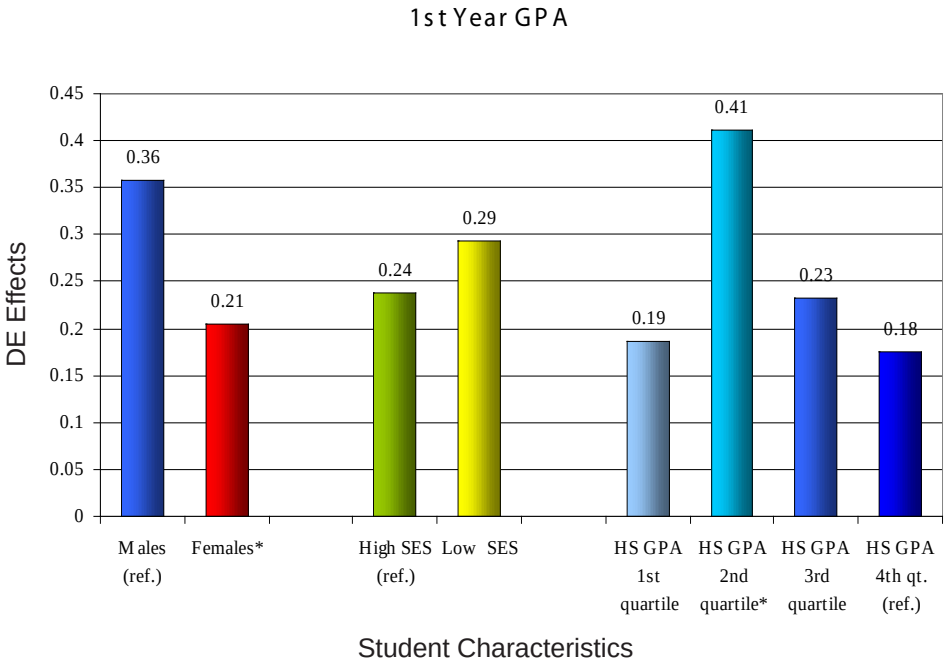
*Figure 2a.* Varied Effects of Dual Enrollment Programs on First-Year Grade Point Average Among all Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year; disability; Limited English Proficiency (LEP); proportions of black, Hispanic, and free/reduced lunch students; charter school; school grade; median household income of residents; proportion of residents with college or higher education; and location.

* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

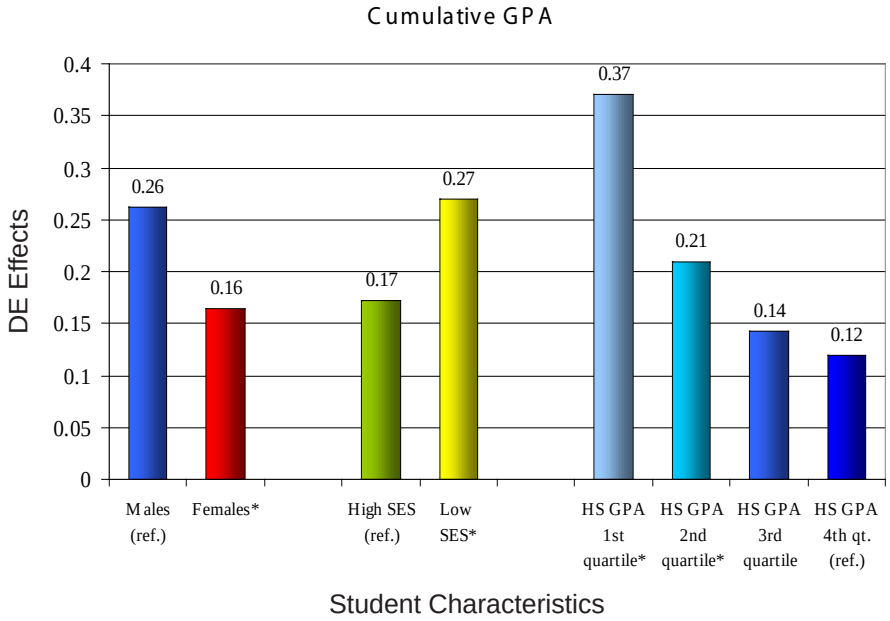
*Figure 2b.* Varied Effects of Dual Enrollment Programs on First-Year Grade Point Average Among CTE Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year; disability; Limited English Proficiency (LEP); proportions of black, Hispanic, and free/reduced lunch students; charter school; school grade; median household income of residents; proportion of residents with college or higher education; and location.
* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

We were curious to see if these differences remained over time, and so ran an analysis of the sub-group differences for dual enrollment participation on cumulative grade point average. For the full sample, the findings were similar, as shown in Figure 3. Male, low-SES, and low-achieving students all seemed to benefit more than female, high-SES, and high-achieving students. However, these differences did not remain for CTE students, since there were no statistically significant differences on cumulative GPA by sub-group (not shown).

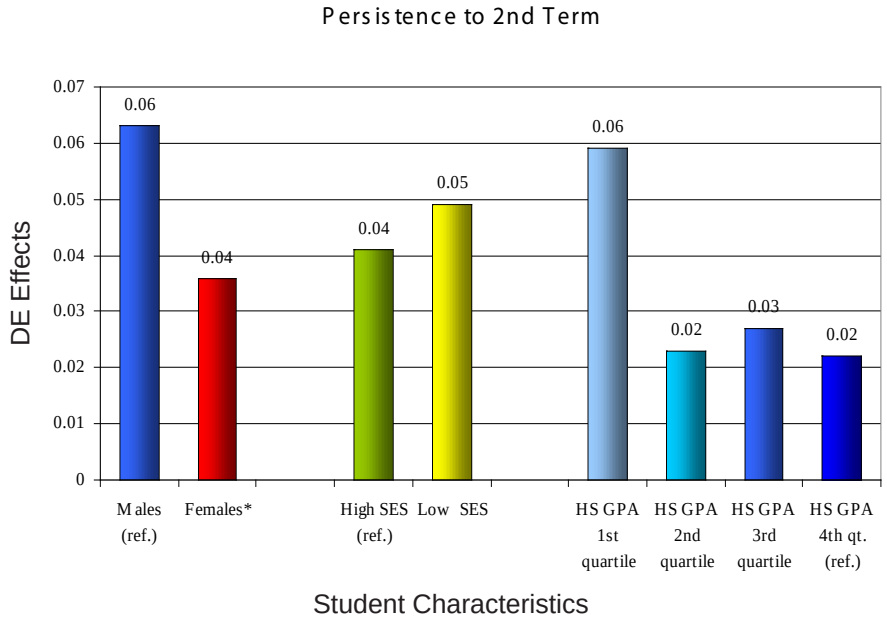
*Figure 3.* Varied Effects of Dual Enrollment Programs on Cumulative Grade Point Average Among all Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year; disability; Limited English Proficiency (LEP); proportions of black, Hispanic, and free/reduced lunch students; charter school; school grade; median household income of residents; proportion of residents with college or higher education; and location.
* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

Regarding persistence to the second year, for both the full sample and the CTE sub-sample, males benefited to a greater extent than females. These relationships are shown in Figures 4a and 4b, respectively.

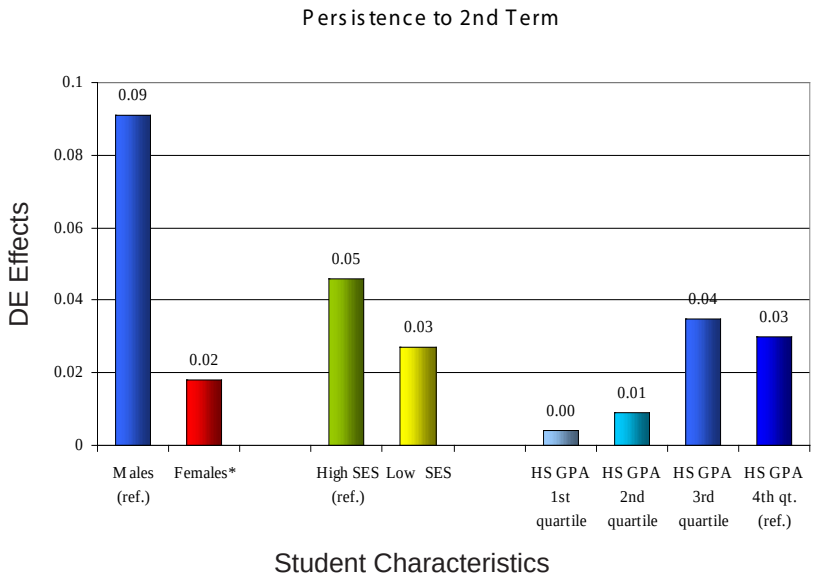
*Figure 4a.* Varied Effects of Dual Enrollment Programs on Persistence to Second Term Among all Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year, disability, Limited English Proficiency (LEP), proportions of black, Hispanic, and free/reduced lunch students, charter school, school grade, median household income of residents, proportion of residents with college or higher education, and location.

* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

*Figure 4b.* Varied Effects of Dual Enrollment Programs on Persistence to Second Term Among CTE Students in Florida




*Note:* DE effects are computed from separate regressions by gender, socioeconomic status (SES), and high school GPA quartiles. Explanatory variables commonly include cohort year, disability, Limited English Proficiency (LEP), proportions of black, Hispanic, and free/reduced lunch students, charter school, school grade, median household income of residents, proportion of residents with college or higher education, and location.
* A difference in DE effects between one group and a reference group are significant at the 5 percent level.

There was a slight differential impact on the total number of credits earned, with dual enrollment participation more positively influencing the total number of credits earned for low-SES students; it did not do so for males or low achievers (not shown). This relationship disappears for the CTE sub-sample, with no differential impacts on total credits earned for CTE students (not shown).

As with the analyses for participation generally, these are encouraging findings regarding the influence of dual enrollment on the types of students who tend to be less successful in college. Males, low-income students, and low-achieving high school students all appear to benefit from participation in dual enrollment to a greater extent than their dual enrollment peers who enter college courses with more social, economic, and educational advantages. This indicates that dual enrollment may well be a strategy for encouraging postsecondary success among students not typically seen as college-bound. It also indicates that, contrary to the arguments of some critics of expanding dual enrollment programs, dual enrollment can benefit a range of students, not only those who achieve at very high levels in high school. Indeed, dual enrollment may be most beneficial to those students who are often excluded from participation.

## STUDY CONCLUSIONS

The findings presented here provide a very encouraging, though not definitive, picture of dual enrollment as a strategy for encouraging student access to and persistence in postsecondary education. This study examined dual enrollment in two states, Florida and New York. In both states, we were able to explore the impact of dual enrollment on a particular sub-group of students, those enrolled in career and technical education (CTE) programs of study. In Florida, we were also able to examine the impact of dual enrollment participation on the broader high school student population. Thus, our findings speak to the efficacy of dual enrollment as a general high school reform strategy as well as to the more specific case of CTE reform.

We examined dual enrollment impacts on a range of outcomes using statistical methods that allowed us to control for student characteristics including high school achievement and family background. As such, this report is an important step forward in the dual enrollment literature because it provides a more rigorous assessment of the relationship between dual enrollment participation and postsecondary outcomes than has been conducted in the past. By including CTE students, our analyses also focus on a sub-population that is often overlooked in the college access literature.

The analyses focused on both short- and longer-term outcomes. They also investigated whether some sub-groups, particularly those students from groups least represented in higher education, may benefit from dual enrollment to a greater extent than their more advantaged peers. In general, we found positive effects from participation in all areas, and though we would encourage future research to use additional control variables for student background and motivation, we believe that our findings provide strong evidence that dual enrollment can be an effective transition strategy for a range of students, not only those most academically successful in high school.

For the full population of students in Florida, we found several consistently positive and statistically significant differences in outcomes. Dual enrollment students in Florida were more likely than comparison students to earn a high school diploma, to enroll in postsecondary education in the state university system, to enroll in college full-time, and to have higher grade point averages (after the first and fourth semesters and cumulatively). This effect on GPA is particularly important because its effect size remains strong in the long run. Importantly, the impact varies by the number of dual enrollment courses taken, indicating an intensity effect for participation. For example, students who took only one dual enrollment course had a 0.158 point higher cumulative GPA while those students who took five or more had almost a 0.27 point difference.

We also found a strong statistical association with persistence in college as well as a large impact on the total postsecondary credits earned. Dual enrollment participants had earned, on average, 15 more credits than their non-dual enrollment peers, but those who took more than five dual enrollment courses had a 25-credit advantage.

But what about CTE students? We were able to use data from the two states to examine whether dual enrollment participation could benefit them. Here, too, we found some consistently

positive and statistically significant differences. These differences were consistent for CTE students across both states.

Dual enrollment students in our CTE population were 8.6 percent more likely than comparison students to enroll in the state university system in Florida and 9.7 percent more likely to pursue a bachelor's degree in CUNY. While we found statistical impacts on GPA and total postsecondary credits earned in both states, the difference was larger in Florida. Dually-enrolled CTE students in both states were also more likely than their non-dually enrolled peers to progress toward a degree, as evidenced by their accrual of significantly more credits after three (Florida) or three-and-a-half (CUNY) years.

Estimated impacts on other outcomes were positive and significant in Florida but not statistically different from zero in CUNY. For example, Florida CTE dual enrollment students were more likely than non-participants to persist in college, but we found no effect or weak evidence for similar effects on such students in CUNY (after accounting for intensity). Moreover, we found a 0.26 point long-term effect on GPA (2nd year and cumulative) for Florida. However, the short-term effect on GPA for CUNY did not translate to the long run until we accounted for the intensity of dual enrollment courses.

There are several possible explanations for the larger statistical differences in Florida. On one hand, it is possible that dual enrollment programs are more effective for CTE students in Florida than in CUNY. On the other hand, the gap could be due to technical differences. For example, we used different definitions of CTE students in each state due to data restrictions. If the definition of occupational concentrators we used in Florida did not accurately capture a population similar to the CUNY CTE sample, then results might differ. Moreover, we included controls for student, high school, and neighborhood characteristics in our models but used very different covariates in each state based on availability. The difference in our ability to control for observable and unobservable factors could also explain differential impacts. Finally, we may simply not have had adequate power in CUNY to detect a small statistical program effect.

Finally, using the Florida data set, we examined whether dual enrollment had stronger effects for certain groups of students than for others. We found that in some cases, males and low-SES students did benefit from dual enrollment to a greater extent than their female and high-SES peers. This was particularly true for students' likelihood of enrolling in college after high school graduation and their grade point averages, both after the first semester and cumulatively. Though these relationships were stronger for the full sample than for the CTE sample, some of the relationships did exist for CTE students as well. Thus, there is at least some evidence that dual enrollment may increase the likelihood of college success for those groups of students currently most disadvantaged in the postsecondary sector.

It is reasonable to conclude, then, that dual enrollment holds strong promise for improving the postsecondary outcomes of all students, including those in CTE programs and those from disadvantaged backgrounds. However, it is important to remember that there were some short-

comings in our analyses that may limit the strength of our conclusions. Results presented here should be interpreted with some caution, and future research is needed to establish a causal relationship between dual enrollment participation and educational outcomes.

The primary shortcoming of both data sets is the non-random nature of dual enrollment participation. Dual enrollment students in both Florida and New York City had to exhibit some preexisting motivation and desire to enroll in college, as they elected to take college classes while still in high school. The limitation of our sample in New York City to only students in vocational high schools (who had some sort of propensity toward technical education while in middle school) and only those who enrolled in CUNY (who therefore had some desire for postsecondary education upon high school graduation) mitigates this to an extent. However, there are still likely preexisting unobserved differences between College Now participants and non-participants that could also generate what appear to be positive impacts, when in fact there are no such impacts or there are negative impacts.

In the Florida data, the differences between treatment and comparison groups were more problematic. The majority of the dual enrollment students met the 3.0 grade point average requirement, meaning that they likely had stronger academic backgrounds than non-participants. The descriptive characteristics of the two samples bear this out, indicating that dual enrollment students in Florida were more advantaged than comparison group students on a range of characteristics. If dual enrollment participants are fundamentally different from non-participants even after adjusting for observable covariates, then the estimated effect of the program may, in part, be attributable to preexisting differences.

However, despite our non-experimental design, our study greatly improves on methodologies used in previous examinations of dual enrollment outcomes and can serve as a baseline study for future experimental and quasi-experimental designs. Both longitudinal datasets allowed us to control for some preexisting student characteristics, particularly for the fact that, in general, dual enrollment students are more successful in high school than their non-dual enrollment peers (using CUNY College Admissions Averages and final high school GPA in Florida). Our results for all students in Florida are robust, consistently positive, and statistically significant; therefore, we are confident that some of these differences in students' outcomes can be attributed to the dual enrollment program.

In addition, the inclusion of analyses focusing only on CTE students and the positive findings emerging from these analyses strengthen the case that dual enrollment can lead to positive outcomes. As we have noted, students who choose to engage in CTE-focused courses of study are likely to be more similar in terms of their college and career goals and high school experiences than the broader high school population. To be sure, students engaged in information technology programs are likely to differ from those in cosmetology programs, who are likely to differ from those in automotive technology programs. However, CTE students are more likely to be similar to one another on unmeasured characteristics than they are to the highest-achieving university-bound students. We believe that comparing dual enrollment-participating and non-dual

enrollment-participating CTE students may help to minimize any potential bias due to self-selection into dual enrollment, although this restriction will not necessarily eliminate all preexisting differences. We found positive results in postsecondary enrollment, total number of credits earned, and GPA across states, in addition to statistical differences in Florida for persistence to the second term and year.

## Implications for Programs and Policy

These positive findings have implications for policy and programs. First, they indicate that the expansion of dual enrollment may be warranted and that states should consider ways to encourage participation among a broad range of students. They also indicate that programs should consider ways to ensure that all students, not just the most academically advanced, have access to dual enrollment opportunities. As some states and programs have expressed reservations about expanding dual enrollment, the findings presented here should provide evidence that their concerns may be unwarranted.

However, additional research is needed to further establish the efficacy of dual enrollment as a promising high school and CTE reform strategy. This includes analyses using randomized or quasi-experimental designs to eliminate some of the shortcomings of our regression analyses. This also includes further examining sub-group differences in outcomes in order to better understand which groups of students may benefit most from dual enrollment participation. While the findings presented here give us confidence that dual enrollment can help students enter and succeed in college, it is important that any policy or programmatic changes be accompanied by rigorous research.

The implications of the findings presented in this report can be seen as pertaining to two separate arenas: dual enrollment generally and CTE reform. In both, policy and programming may be influenced by the positive relationship between dual enrollment and student outcomes found in our analyses.

### Implications for Dual Enrollment Programs

1. Consider expanding dual enrollment participation.

States and programs may want to reconsider restrictive eligibility requirements for dual enrollment, given the finding that both CTE and non-CTE students benefit from participation. Moreover, the finding that the most disadvantaged students (males and low-SES students) benefit more than others indicates that a rethinking of who should be included in dual enrollment is necessary.

In many states, as in Florida, students with low grade point averages, including those who may be disengaged from traditional academic study, are prohibited from participating in dual enrollment. Although further research is needed to establish the extent to which disadvantaged subgroups benefit from participation in dual enrollment, it appears that states may want to reconsider restrictive eligibility policies. Likewise, some colleges limit which students may enroll in dual

enrollment courses or limit which courses are available to students (often offering liberal arts courses but not electives or CTE classes). Colleges should reconsider whether these restrictions are appropriate.

2. Consider creating dual enrollment sequences.

We found some preliminary evidence that students benefit from taking more than one dual enrollment course. States can encourage such course-taking by developing policies that support comprehensive or enhanced comprehensive dual enrollment programs that span multiple semesters and sometimes include additional support services (Bailey & Karp, 2003). Since these programs are often more expensive to run than single dual enrollment courses, state support and funding may be a necessary precursor to their expansion.

Programs can encourage intensity of course-taking in a variety of ways. First, they can ensure that students are recruited into dual enrollment early enough in their high school careers that they have the time to take multiple courses. Second, they can work with students during the course selection process to help them develop clear sequences of courses. This may even include "bundling" dual enrollment opportunities, such that students enroll in the first level of a course during the fall semester and the second level during the spring (e.g., English 101 in the fall and English 102 in the spring).

3. Expand outreach to underserved populations.

Because underrepresented students may not have the same opportunities to learn about dual enrollment opportunities as their peers or may be less inclined to take advantage of such opportunities, it is important to ensure that states and programs pay particular attention to the recruitment of such students. States can encourage the participation of disadvantaged groups in dual enrollment by requiring notification of all students of the availability of dual enrollment, providing funds to create outreach programs for underrepresented groups, or creating their own outreach programs for such groups.

Programs themselves can take the lead in this area by being proactive in their outreach and recruitment efforts. This may include the targeted marketing of programs, such as special events for underserved students. They may also devote staff members specifically to recruiting underserved students. Perhaps most importantly, programs must critically examine their current practices and cultures and identify ways in which their current practices may discourage minority and low-SES student participation and seek alternatives.

Most importantly, dual enrollment courses should be tuition-free for low-income students (if not for all students). The 50 states address dual enrollment tuition in several different ways, with some mandating that participating students pay their own tuition and others requiring that participating institutions cover tuition, with either the secondary institution covering the cost, the postsecondary institution forfeiting tuition, or a combination of these methods (Karp et al., 2005). A handful of states provide state funding for tuition. This latter arrangement is clearly the best, since requiring institutions to cover costs can create a disincentive to participation. Given

the realities of tight state budgets, states that cannot afford tuition coverage for all participating students might implement a sliding scale to ensure that tuition does not deter disadvantaged students from enrolling.

## Implications for CTE Programs

1. Expand dual enrollment options for CTE students.

The positive findings presented here indicate that dual enrollment can benefit CTE students. In many locales, however, such students are not encouraged to participate in dual enrollment. This is changing somewhat as more CTE programs encourage college preparation and attendance. However, connections between colleges and high school CTE programs should be strengthened so that CTE students have additional opportunities to engage in college coursework while in high school.

At the state level, this means that modifications in policy may have to occur. Some states target dual enrollment to academically advanced students and direct funds away from CTE students seeking such opportunities as a result. Such policies should be rethought in order to encourage more CTE student participation in dual enrollment. At the program level, long-held beliefs about which students should participate in dual enrollment and which courses should be offered must also be reconsidered. New relationships between dual enrollment coordinators and high school CTE teachers should be developed, and dual enrollment recruiters should seek ways to target CTE students for program participation.

2. Expand integration of dual enrollment in CTE pathways and programs.

The current trend in CTE reform is to include dual enrollment as part of a sequence of CTE courses. This builds upon and improves Tech Prep and other reforms. There has been some skepticism as to the efficacy of this approach. Our findings, however, indicate that initiatives such as CCTI are on the right track when they seek ways to combine CTE pathways and dual enrollment opportunities.

Although we did not compare the outcomes of Tech Prep and dual enrollment CTE students directly, our positive findings (particularly as compared to previous more-negative findings on Tech Prep) indicate that dual enrollment should be an important component of CTE programs. Providing CTE students with structured opportunities to engage in dual enrollment coursework is likely to increase CTE students' access to and success in college.

As states redefine their CTE programs in response to reforms in Perkins funding, they should seek policy levers to encourage the creation of pathways that include dual enrollment for CTE students. This may include funding streams that reward programs with a dual enrollment component or other levers to encourage dual enrollment over the traditional articulated credit or credit-in-escrow models. At the institutional level, collaborations between high schools and colleges should focus on ways that dual enrollment can be integrated into existing and new curricular pathways.

In conclusion, this study offers very encouraging, though not definitive, findings that dual enrollment participation is related to positive postsecondary outcomes. This positive association is particularly strong for groups of students that have been struggling to succeed in postsecondary education, especially males and low-income students. Also intriguing are our results relating to students with high school grade point averages in the lowest quartile (in this case, below 2.6), indicating that these students may benefit from participation more than their high-achieving peers.

Although our positive findings may stem from unmeasured student characteristics such as motivation, it seems that at the very least, dual enrollment programs provide motivated students with the opportunity to accelerate their education. Given these results, we suggest that states and colleges push forward with their dual enrollment initiatives but with a much stronger commitment to develop more definitive measures of effectiveness.

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