



TEACHERS COLLEGE, COLUMBIA UNIVERSITY

**High School Dual Enrollment in Florida:
Effects on College Outcomes by Race/Ethnicity and Course Modality**

Summary Research Report

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Abstract

This report presents findings on the relationship between taking community college dual enrollment courses—in which high school students earn high school and college credits simultaneously—and college outcomes among Florida public high school students. It analyses dual enrollment course-taking by racial/ethnic group (Black, Hispanic, White) and course modality (face-to-face on-college-campus, face-to-face off-campus, and online). The report includes (1) a descriptive analysis of the demographic characteristics and outcomes of dual enrollment participants and (2) multivariate regression analyses of the associations between dual enrollment participation and college outcomes, controlling for a rich set of student and school characteristics. The analyses use transcript-level unit record data on two cohorts of Florida students who started public high school in 2007 and 2012 and were tracked through high school and into Florida state colleges (community colleges) and universities. We find that Florida high school students who took dual enrollment courses were more likely to be White, female, and from more affluent backgrounds than those who did not take dual enrollment courses. We also find that taking dual enrollment courses is associated with better college outcomes for all racial/ethnic groups considered, and that the effects of dual enrollment are mediated by course modality, such that taking courses online is associated with slightly smaller benefits than taking courses face-to-face.

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1. Introduction and Overview

Dual enrollment—in which high school students take courses for postsecondary as well as high school credit—has existed as a college acceleration opportunity for decades (Andrews & Marshall, 1991; Gerber, 1987; Mokher & McLendon, 2009). It has grown substantially since the 1990s, as educators and policymakers have sought ways to both improve high school graduates' college readiness and lower the costs and debt burden of college (Karp, 2012). Nationwide, one third of students who began high school in fall 2009 participated in dual enrollment (Azim & Wilson, 2019).¹ And the number of part-time students in college under the age of 18, most of whom were high school students, doubled between 2007 and 2017 (Fink et al., 2017). Despite the rapid growth in dual enrollment participation over the past two decades, only a handful of studies have used quasi-experimental designs to estimate the effects of dual enrollment on college outcomes (An, 2013a; An, 2013b ; Giani et al., 2014; Hemelt et al., 2020; Miller et al., 2018; Speroni, 2011a, 2011b). These studies have found that taking dual enrollment courses is associated with higher rates of college-going and attempted credits in the first semester of college. Studies also have also found that dual enrollment participation is related to better long-term outcomes, such as college persistence and degree attainment (e.g., Allen & Dadgar, 2012; An, 2013b; Berger et al., 2013; Blankenberger et al., 2017; Edmunds et al., 2020; Giani et al. 2014; Jones, 2014; Struhl & Vargas, 2012).

The existing literature has demonstrated that students benefit from dual enrollment opportunities in general, but there is less consensus on how dual enrollment affects students from different racial/ethnic groups. Studies examining the relationship between dual enrollment and college outcomes by racial/ethnic group have found mixed results (Miller et al., 2018; Struhl & Vargas, 2012). Moreover, there are clear racial/ethnic group disparities in participation in dual enrollment and other college acceleration programs (Museus et al., 2007; Xu et al., 2019); U.S. Government Accountability Office, 2018), so it is important to examine whether students from groups

¹ Dual enrollment courses are the second most common means (following Advanced Placement courses) by which high school students in the United States earn college credit, with 1.4 million students participating in 2010-11 (College Board, 2017).

traditionally underrepresented in higher education—and in particular Black and Hispanic students—benefit from dual enrollment differently than their White peers.

Course modality is also important. Dual enrollment includes several types of college course-taking arrangements. The courses may be offered at either local high schools that partner with a college or on college campuses. Each setting exposes students to different academic environments and may require different transportation needs, which potentially leads to differential impacts on students' college enrollment decisions and performance. What is more, to expand access to dual enrollment opportunities, many colleges have also started offering dual enrollment courses through an online delivery format. Yet existing studies, especially those conducted at community colleges, have consistently found that fully online courses are associated with high mid-semester withdrawal rates and low course success (Hart et al., 2018; Xu & Jaggars, 2014). Worse still, weaker performance in online courses has been most pronounced among Black students and students with lower GPAs (Xu & Jaggars, 2014). Given the uncertainty surrounding the effectiveness of various course-taking arrangements, it is critical to explore how students perform in dual enrollment courses with different locations and delivery formats.

1.1 Study Setting and Research Questions

This summary report shares findings from a study that examines the characteristics of students who take dual enrollment courses in Florida, the effects of dual enrollment course-taking on outcomes for students overall and by race/ethnicity, and the differential effects by course location and delivery method. The Community College Research Center partnered with the Florida Department of Education to conduct the study, using data on two cohorts of Florida students who began high school in 2007 and 2012. Originally established in 1979, Florida's dual enrollment program is one of the oldest in the nation. The program's three goals are to: (1) reduce students' time to degree, (2) diversify the curricular options available to high school students, and (3) deepen study among students in a particular subject (Hunt & Carroll, 2006). Today, Florida's academic dual enrollment (hereafter, DE) program allows sixth to twelfth graders to simultaneously earn credits toward high school and associate or bachelor's degrees at Florida public postsecondary institutions. To be eligible to participate in the DE program in Florida,

students must have a minimum unweighted GPA of 3.0 and meet the minimum score requirement of a common placement test that indicates the student is ready for college-level coursework (Florida Statute 1007.271, 2019). Although any Florida college or university may offer DE courses, the vast majority of courses are offered through the Florida College System, previously known as the Florida Community College System, composed of 28 community colleges throughout the state.

This study considers high school students who take college courses through community colleges (called state colleges in Florida) or universities. This constitutes the most traditional form of DE. The study excludes students in Early and Middle College High School (EMCHS) programs, another form of DE; most students in these programs enroll in courses for college credit full-time.² We focus on traditional DE in part because it is the most popular dual credit model in the state, so it has a greater potential to reach a broad range of students. Also, unlike EMCHS programs, which have been rigorously evaluated with randomized controlled trials (e.g., Berger et al., 2010, 2013; Edmunds et al., 2012), the evidence base on traditional DE is still developing, and questions remain about who participates and whether and how they benefit.

We address the following research questions in this study:

1. Do the characteristics of Florida students who take DE courses differ from those who do not, and if so, how?
2. What is the association between DE participation and college enrollment and short- and long-term college performance outcomes?
3. Do these relationships differ for Black and Hispanic students relative to White students?³
4. Do these relationships vary by course location and delivery method (on-college-campus face-to-face, off-college-campus face-to-face, and online)?

To answer these questions, we conduct descriptive analysis and multivariate regression analysis of administrative data collected by the Florida Department of

² These programs are also called collegiate high schools in Florida.

³ Asian students and Native American/Alaska Native students are excluded from this analysis in order to focus on a comparison of the three major racial/ethnic groups in the sample. Asian students represent 3.6% of all students, and Native American/Alaska Native students represent 0.35%.

Education on student characteristics, course-taking patterns, and high school and college outcomes of students in the Florida high school ninth grade cohorts of 2007 and 2012.

1.2 Key Findings and Limitations

The most notable findings from this study include the following:

1. *Participation.* Students from some demographic groups were more likely than others to participate in DE in Florida. DE students were more likely to be White, female, and less likely to participate in free or reduced-price lunch than students who did not participate in DE.
2. *Outcomes.* DE participation is positively correlated with a wide range of college outcomes, including college and university enrollment, full-time college enrollment, college persistence in the first year, and degree attainment for Black, Hispanic, and White students.
3. *Course modality differences.* Across most outcomes, students who took more than half of their DE credits face-to-face on a college campus experienced the strongest benefits, followed closely by those who took DE primarily face-to-face off-campus.⁴ While students who primarily took DE through online formats still benefitted from DE compared to non-DE students, with some subgroup exceptions, the sizes of the benefits were generally a little smaller than for those who took DE through face-to-face delivery.
4. *Racial/ethnic differences.* Compared to non-DE peers in the same racial/ethnic group, Black and Hispanic students were more likely to enroll in state universities and less likely to enroll in state colleges (Florida's equivalent of community colleges). By contrast, DE participation is associated with higher enrollment rates at both universities and community colleges among White students. In terms of modality, one major distinction arises: Black students who took DE primarily online (rather than face-to-face) had the most desirable outcomes compared to their same racial/ethnic group non-DE peers; whereas among Hispanic and White students, those who took DE primarily face-to-face had the largest gains.

⁴ We have accurate location and delivery method information only from Florida community college data. For the location, there are two options in the data: (1) community college campus and (2) high school or a branched community college campus, such as a career center. We are thus unable to identify whether a particular course was offered at a high school or at a branched college campus for off-campus locations.

This is one of the first studies to provide descriptive statistics on DE course-taking and to analyze DE outcomes by race/ethnicity and course modality using administrative data on large cohorts of students. Yet it is important to recognize that DE and non-DE students are very different in terms of their background characteristics, and these differences may influence their eventual outcomes. Despite controlling for extensive student and school characteristics in our multivariate regressions, our results do not fully take into account selection bias in participating in DE and thus should not be interpreted as causal estimates.

1.3 Organization of This Report

The remainder of this report is organized as follows: Section 2 reviews previous research on the effects of taking DE courses on college outcomes among students by race/ethnicity and by course modality (on-campus/off-campus and face-to-face/online). Section 3 describes the data and methods used in this paper. Section 4 provides a detailed descriptive analysis of research question 1. Section 5 presents the multivariate regression results on research questions 2 through 4. Section 6 discusses our findings.

2. Policy Background

Dual enrollment has been used as a blanket term to describe many different models that allow high school students to earn college and high school credits at the same time.⁵ In a national DE policy analysis, Borden et al. (2013) identified 97 unique terms that are used to describe DE programs; the most common terms are “dual enrollment,” “dual credit,” and “concurrent enrollment.” In this section, we broadly define DE as an opportunity for students to simultaneously earn credits toward their high school graduation requirements and a postsecondary degree.

Early and Middle College High School (EMCHS) is one of the most extensively studied DE models. In an EMCHS system, students have extensive opportunities to earn college credits and have access to comprehensive support services such as counseling,

⁵ In Florida, dual enrollment allows students in grades 6-12, including home education and private school students and students with disabilities, to take college coursework and simultaneously earn credit toward a high school diploma.

mentoring, and assistance with college applications (Berger et al., 2010; Bailey & Karp, 2003). Many studies—including those using randomized controlled trials (Edmunds et al., 2020; U.S. Department of Education, 2017)—have found positive outcomes associated with EMCHS. Yet, as An and Taylor (2019) have pointed out, DE is only one element of the design: EMCHS systems are unique compared to traditional DE programs. It is therefore important to understand the effects of the simplest form of DE, in which high school students take a college course taught by a college instructor or a high school teacher with college instructor qualifications on a college campus, in a high school, or online. This simpler form is much more prevalent and has a greater potential to benefit students on a large scale.

2.1 Growth and Participation in Dual Enrollment

Between the 2002-03 and 2010-11 school years, the number of students participating in DE (including in EMCHS programs) nearly doubled, jumping from 813,000 to 1.4 million students (Kleiner & Lewis, 2005; Marken et al., 2013). More recent data indicate that DE participation among students aged 17 and younger has continued to grow nationwide since 2011, with programs taken through community colleges accounting for about 70% of DE headcounts nationally in 2015 (Fink et al., 2017). As for our state of study, Florida, 7% of all high school students participated in DE in the 2015-16 school year (Fink, 2018), compared to 8% nationally. Similar to the national trend, postsecondary fall enrollments among students in Florida aged 17 or younger (mostly DE students) more than doubled from 2009 to 2017, rising from 25,000 to 65,000 students (Fink et al., 2017).

2.2 Dual Enrollment Outcomes

Observational research has generally found a positive association between traditional DE course-taking and high school students' academic choices and postsecondary success (An & Taylor, 2019). However, given the mounting evidence of noticeable disparities in DE access and participation across different subpopulations (U.S. Government Accountability Office, 2018), descriptive studies that compare the outcomes of DE and non-DE students directly are likely confounded by selection bias in DE participation. In particular, DE students are more likely to be high-income, female,

White, Asian, and high-achieving students who are likely to have better outcomes regardless of participation in DE (Fink et al., 2017; Xu et al., 2019). Therefore, it is unclear whether the benefits associated with DE that have been observed in descriptive analyses are indeed the results of DE participation or are simply due to baseline differences between students who decide to enroll or not enroll in these programs.

More recent studies that rely on better data, however, have been able to evaluate DE with quasi-experimental and experimental methods. The results of these studies have been mixed. Six quasi-experimental studies that examined outcomes such as first-year college performance (An, 2013a, 2015), college degree attainment (Allen & Dadgar, 2012; An, 2013b, Blankenberger et al., 2017; Giani et al., 2014), and time-to-degree (Allen & Dadgar, 2012) found DE to have a positive impact on DE participants. All of these studies except for Allen and Dadgar (2012), which used a differences-in-differences approach, implemented a propensity score matching approach (PSM). However, despite the positive results of these six studies, three other quasi-experimental and experimental studies found null to mixed impacts of DE participation on student outcomes. Using the DE participation rate of other students in the same entering cohort as an instrumental variable, Miller et al. (2018) found that in Texas, DE increased the probability of two-year college enrollment but had no impact on the probability of four-year college enrollment or degree attainment. Additionally, Hemelt et al. (2020) studied the effects of DE algebra courses in a randomized control setting in Tennessee and found that taking such courses led students to choose four-year over two-year colleges. They also found that taking DE algebra courses did not impact the likelihood of college math course enrollment, completion, or withdrawal in the first year of college. Finally, using a regression discontinuity method and data on Florida high school seniors from 2000 to 2002, Speroni (2011) found that DE had no consistent impact on college outcomes for students near the high school GPA cutoff used to determine program eligibility.

2.3 Equity Concerns

While many students, including those from underserved racial/ethnic groups and those who are low-income (Grotsky & Jackson, 2009; Ross et al., 2012), face challenges enrolling in and succeeding in college, the rapid expansion of DE offerings described above has not affected all students equally. A number of reports have identified

noticeable disparities across subpopulations in terms of both access to and participation in DE (U.S. Government Accountability Office, 2018; Xu et al., 2019), and studies have typically found that DE students are more likely than their non-DE peers to be high income, female, White, Asian, and high-achieving (Fink et al., 2017; Pierson et al., 2017; Pretlow & Wathington, 2014; Young et al., 2013).

This DE participation gap is especially concerning because DE can potentially be a useful tool in narrowing equity gaps along racial/ethnic and socioeconomic lines. Students from some racial/ethnic groups may have, on average, fewer financial resources and less cultural and social capital than their White peers (Lile et al., 2018). For example, compared to White students, Black students may have more limited access to relatives and role models who have gone to college before. DE courses, especially those that expose students to college norms and the college environment, may be particularly beneficial to underserved students in preparing and motivating them to become college-bound.

To close equity gaps in DE participation and increase the number of underrepresented students who graduate from high school prepared to enroll and succeed in postsecondary education, educators and policymakers in many states are increasing investments in college acceleration strategies. So far, only a handful of observational studies have examined the effects of DE on outcomes by racial/ethnic subgroups; they suggest that DE can benefit all students but that benefits may differ based on students' race/ethnicity or socioeconomic background (Karp et al., 2007; Struhl & Vargas, 2012).

2.4 Dual Enrollment Course Modalities

Although research indicates that, in general, DE improves student outcomes, it is important to consider that DE programs and courses come in different shapes and sizes. Miller et al. (2017) noted that the way DE courses are taught is often driven by logistical factors; resource constraints; and the preferences of high schools, districts, and colleges. For example, Miller et al. (2018) studied DE course delivery and instruction in Texas and found that it is challenging for rural districts to offer face-to-face and college-based DE courses since high schools are far away from colleges. They also found that some colleges had to hire teachers from high schools to teach DE classes on the college campus. Finally, colleges and school districts may have different preferences on DE

course delivery. While school districts may want students to take DE courses in their high schools so they can participate fully in high school activities, college faculty may prefer that students take DE courses on a college campus.

Some estimates suggest that around three quarters of DE courses are taught in high schools, while the remainder are taught on college campuses or online (Thomas et al., 2013). On the one hand, taking DE courses in high schools offers students a more familiar environment and eliminates transportation difficulties, scheduling adjustments, and other logistical costs and complexities. On the other hand, proponents of taking DE courses on college campuses say that doing so can better prepare students for college by exposing them to a wider range of available courses (Friedman et al., 2011), more diverse peers, and college norms and instruction styles (Burns & Lewis, 2000; Karp et al., 2012; Miller et al., 2018; Thomas et al., 2013; Zimmermann, 2012).

Evidence on the effects of offering DE courses on or off a college campus is sparse and inconclusive. Some descriptive analyses have found that college-based DE improves higher education aspiration (D'Amico et al., 2013; Smith, 2007), likelihood of full-time college enrollment, first-semester grades (Wintermeyer, 2012), and retention rates from the first to the second year (D'Amico et al., 2013). However, other studies have found contradictory results on the same outcomes or no differences across DE course locations (Henderson, 2019; Speroni, 2011; Villareal, 2018; Wallace, 2017).

Regarding online versus face-to-face delivery, the share of DE courses taken online nationally grew from 2% to 6% between 2002-03 and 2010-11 (Waits et al., 2005; Thomas et al., 2013) and has likely grown since, given the continued growth in college online course-taking. Research on online DE is sparse, but the online education literature has generally found that college students who take a course online have more negative outcomes than their peers taking the same course face-to-face (Alpert et al., 2016; Bettinger et al., 2017; Figlio et al., 2013; Streich, 2014; Xu & Jaggars, 2013, 2014). Drawing on the educational psychology literature, researchers have argued that technology-enhanced, student-centered online learning requires students to assume greater responsibility to engage in the learning process, relative to traditional learning contexts. Many students, especially those from disadvantaged backgrounds, need additional support and scaffolding to be successful in an online learning environment that

is characterized by self-direction and self-regulation (Corbeil, 2004; Xu & Jaggars, 2014). However, despite the challenges of online learning, online DE courses offer more flexible scheduling (Xu & Jaggars, 2014), so there may be a case for expanding DE access and course availability through online delivery. Doing so could be especially helpful for students who are far away from a college campus, may not have adequate means of transportation, or attend a high school with limited DE course offerings (Holian et al., 2014).

The small number of studies examining course delivery methods have found conflicting results in DE course performance across delivery environments. Using analysis of variance (ANOVA), Arnold et al. (2017) and Flores (2012) found no differences in DE course grades in courses offered through face-to-face and online platforms. Using the same method, Martin (2014) found that DE students earned higher final course grades when taking courses face-to-face.

While the current literature provides important insights into the differential effects of DE by modality (on- versus off-college-campus, online versus face-to-face), these studies are often limited to a conditional sample of high school students who later enrolled at community colleges (e.g., D'Amico et al., 2013). They also often focus on observational comparisons that do not take into account demographic differences between DE and non-DE students (e.g., Arnold et al., 2017; Flores, 2012; Martin, 2014; Wallace, 2017). Our study addresses an important gap in the literature by examining DE modality with a more rigorous analytical strategy (i.e., multivariate regression with high school fixed effects), and it uses data from two cohorts of all Florida ninth graders (not just those who eventually enrolled in community colleges).

3. Data and Methods

3.1 Description of Florida Data

Our sample includes the 2007 and 2012 cohorts of all public-school ninth graders in Florida. For both cohorts, we have students' high school and college transcripts, as

well as information on their demographic characteristics.⁶ For the 2007 cohort, our data tracks individuals up to six years after on-time high school graduation. For the 2012 cohort, we track students until the spring after on-time high school graduation. We also have information on DE modality for the 2012 cohort. The modality data indicate whether a course was taken on a community college campus or off-campus in a high school or a community college extension center, as well as which course delivery method was used (online versus face-to-face).

Although individual high schools and colleges may make exceptions on a case-by-case basis, generally, to be eligible for DE in Florida, students are required to have a minimum unweighted GPA of 3.0 and earn the minimum score on a common placement test that indicates that they are ready for college-level coursework (Florida Statue 1007.271, 2019). To take other DE offerings, returning DE students need to maintain a 2.0 GPA in DE courses and the minimum high school GPA established by the school district and college. Because most Florida DE students enroll in DE courses in 11th and 12th grade, we restrict the sample to students who enrolled in high school in both 9th and 10th grade and had no DE participation before 11th grade and remain enrolled through 11th grade. We also exclude high schools with under 15 students. Overall, the analysis uses data from 620 high schools and 48 colleges.⁷

3.2 Methods

Since DE and non-DE students often differ in demographic characteristics and academic performance (more details in the next section), directly comparing the outcomes of DE and non-DE students may result in biased results caused by the differences in student characteristics (rather than differences caused by the taking of DE courses). For example, if DE students tend to be more academically high achieving, they may have better college outcomes regardless of whether they take DE courses.

⁶ It is important to note that the college data include only students who attended community colleges (known as state colleges in Florida) and state universities. Students who attended private and out-of-state institutions are not included in the college data.

⁷ We exclude schools that did not offer 11th or 12th grade, as well as special education, alternative, juvenile justice, and virtual schools.

Section 4 of this report presents summary statistics descriptively. Section 5 presents the results of our multivariate regressions that further adjust for observable student characteristics such as a student’s gender, race/ethnicity, birth month and year, Limited English Proficiency (LEP) status, Free and Reduced-Price Lunch (FRPL) status, as well as prior academic performance (i.e., GPA and total number of credits attempted in 9th grade). We also include high school and cohort fixed effects so that we compare only students within the same high schools and cohorts. It is worth noting that we first tried using quasi-experimental strategies, including fuzzy regression discontinuity and propensity score matching methods, to infer causality. However, the lack of compliance around the cutoff for eligibility and the difficulty in finding comparable matches between DE and non-DE participants limited our ability to detect effects in the resulting analyses. In future research we will explore an alternative strategy—using the availability of DE courses as an instrument to predict DE participation and estimating DE effects by implementing a differences-in-differences with instrumental variable approach.

4. Descriptive Statistics

This section describes the baseline data on DE and non-DE student characteristics, as well as their one-year and three-to-six-year college outcomes. We start by looking at the information by race/ethnicity, then by DE course modality, and finally by both race/ethnicity (Black, Hispanic, White) and modality (on-college-campus face-to-face, off-college-campus face-to-face, online).

4.1 Student Characteristics by Race/Ethnicity

Table 1 describes the demographic characteristics of all DE and non-DE students in columns 1 and 2.⁸ Columns 3 to 6 refer specifically to DE and non-DE Black and Hispanic students, while columns 7 and 8 present the statistics for White students.

Similar to previous studies, in our sample, DE students were more likely to be female, White, and from a more affluent background than students who did not

⁸ Columns 1 and 2 include estimates for Asian and Native American/Alaska Native students, who together represent 4% of our sample.

participate in DE. A lower percentage of Black (11%) and Hispanic students (11%) participated in DE than did White students (19%). Sixty-one percent of all DE students were female, while only 48% of the non-DE students were. DE students were also 18 percentage points less likely to receive FRPL than non-DE students. However, the percentage of students receiving FRPL was much higher for Black and Hispanic students relative to White students regardless of their DE status. Among Black and Hispanic students combined, the percentages of DE and non-DE students with FRPL status were 66% and 75%, respectively. For White students, the corresponding figures are 21% and 34%.

DE students were generally higher-performing academically. Only 13% of DE students were LEP students, compared to 21% of non-DE students. DE students, regardless of their race/ethnicity, had higher ninth grade GPAs than non-DE students (3.4 vs. 2.7). The number of ninth grade credits attempted was similar across DE and non-DE students, as well as across racial/ethnic groups.

The second panel of Table 1 presents short-term outcomes of the 2007 and 2012 cohorts. In general, DE students had better high school and college enrollment outcomes than their non-DE peers, and White DE students had the most positive short-term outcomes of any group. For example, DE students were about 5 percentage points more likely to graduate from high school than non-DE students, regardless of their race/ethnicity. DE students were also 24 percentage points more likely to enroll in college immediately after high school graduation. This difference is greater for White (26 percentage points) than for Black (18 percentage points) and Hispanic (23 percentage points) students. Among the full sample, a greater proportion of students enrolled in a state university (37%) than a community college (32%), but this was not the case for all racial/ethnic groups. White DE students were much more likely to enroll in a university directly after high school than their Black and Hispanic DE peers (40% vs. 31%). Finally, DE students in the full sample had a higher full-time college enrollment rate than non-DE students (58% vs. 33%) and a higher persistence rate (65% vs. 40%) from the first fall to spring than non-DE students. The differences in these outcomes between DE and non-DE students were higher for White than for Black and Hispanic students. The gap between DE and non-DE students for these outcomes was the smallest among Black students.

The last panel of Table 1 presents the baseline differences between DE and non-DE students on longer-term outcomes, such as degree attainment and transfer rate. Similar to the pattern of short-term outcomes, DE students had better outcomes than non-DE students, and the differences within racial/ethnic groups tend to be higher for White students relative to Black and Hispanic students. The six-year bachelor's degree attainment rate was 42% and 15% for DE and non-DE students, respectively. White DE students were approximately 10 percentage points more likely to complete a bachelor's degree in six years than were Black and Hispanic DE students. The full sample of DE students also had a 17 percentage point higher associate degree graduation rate than non-DE students. Once again, White DE students had an overall higher associate degree completion rate than Black and Hispanic DE students, and the difference between DE and non-DE students among students of the same race/ethnicity was higher for White than for Black and Hispanic students. Finally, the transfer rate for DE students was about 6-9% higher than for non-DE students across the three groups.

4.2 Student Characteristics by Dual Enrollment Course Modality

Next, we examine student characteristics, course-taking patterns, and short-term outcomes by DE course modality. In Table 2, column 1 includes all DE students in the 2012 cohort who ever enrolled in a DE course offered through a Florida state college (i.e., a community college). These DE courses were offered at a state college campus, an off-campus college extension center, a high school, or online. Columns 2, 3, and 4 contain the sample of students who took more than 50% of their DE credits online, on a college campus face-to-face, or off-campus face-to-face, respectively. About half of the DE students in our sample (49%) took DE primarily through face-to-face delivery on campus, while another 40% took DE primarily through face-to-face delivery off-campus. Only 9% of DE students took DE primarily online.

Overall, students who used different modalities were similar in terms of demographic characteristics, socioeconomic status, and grade 9 performance, except that Black students were more likely to take DE face-to-face off-campus, Hispanic students were slightly more likely to take DE face-to-face on-campus, and women were less likely to take DE face-to-face off-campus.

Table 2 shows that students tended to take the majority of their DE credits through one delivery format, even though they sometimes may have used other modalities. On average, students took between 74% and 93% of their DE credits in the primary modality of their choice. Notably, compared with students who took the majority of their DE courses face-to-face on- or off-campus, students who took the majority of their DE courses online were much more likely to take courses in other modalities. For example, students whose primary course-taking modality was online took 74% of their DE credits online, 18% of their DE credits face-to-face on-campus, and 8% of their DE credits face-to-face off-campus. By contrast, students whose primary course-taking modality was face-to-face on- or off-campus took 91% and 93% of their credits in their primary delivery format.

In terms of one-year college outcomes, students using different modalities generally performed similarly with two exceptions. Students who mostly enrolled in DE face-to-face on-campus were more likely to immediately enroll in any postsecondary institution after high school graduation than students who primarily enrolled face-to-face off-campus (75% vs 67%). However, these two groups of students have comparable rates of immediate enrollment in a state university. The main differences across modalities are in state college enrollment rates; 36% of students who took the majority of their DE courses face-to-face on-campus enrolled in a two-year college immediately after graduating from high school, while 29% of students who took the majority of their DE courses face-to-face off-campus did so. It is plausible that students who were more exposed to state college campuses were more likely to choose community college as their postsecondary destination. Finally, face-to-face on-campus students had the highest persistence rate from fall to spring in their first year.

4.3 Student Characteristics by Race/Ethnicity and Dual Enrollment Course Modality

Table 3 reports the same statistics as Tables 1 and 2 but by both racial/ethnic group and course modality. The overall patterns are similar to what is observed in the previous two tables, with some patterns specific to particular race/ethnicity and modality combinations. Table 1 shows that a much higher percentage of Black and Hispanic DE students had LEP status than their White peers, and in Table 3, we see that this pattern is more pronounced among Hispanic students who primarily took DE face-to-face (Black,

9%; Hispanic, 37%; White, 2%) as opposed to online (Black, 9%; Hispanic, 30%; White, 1%). Black, Hispanic, and White students had similar academic performance in grade 9 across modalities. Finally, while Table 2 shows that female students were slightly less likely to take the majority of their DE courses face-to-face off-campus than they were to use other modalities, Table 3 shows that Black and Hispanic female students (65%) were more likely than White female students (58%) to take face-to-face off-campus DE courses.

In terms of course-taking patterns, Black, Hispanic, and White students enrolled in a similar number and percentage of credits across each modality. The patterns largely mirror those in Table 2. The descriptive statistics for one-year outcomes across race/ethnicity are very similar for students who primarily took DE courses online as opposed to face-to-face on-campus. The biggest difference across racial/ethnic groups is among students who enrolled in more than half of their DE credits face-to-face off-campus. Black and Hispanic students who took the majority of their DE courses face-to-face off-campus were much less likely to immediately enroll in a university (28% and 34%, respectively) than White students were (41%). Their full-time enrollment and persistence rates were also lower than those of White students, and the disparity is particularly noticeable among Black students. The outcomes for Black and Hispanic students compared to White students primarily taking DE courses through the other two modalities are similar.

5. Multivariate Regression Results

The descriptive differences in outcomes by student characteristics and modalities described in the previous section suggest that taking DE courses may be associated with better college outcomes and that the modality through which students take courses may matter. However, the differences in outcomes may be driven by differences in student characteristics rather than by the effects of DE participation or course modality. In this section, we use multivariate regressions (or an ordinary least squares approach) to examine the differences in outcomes, controlling for key demographic and academic

performance differences before grade 11, which is when most students started taking DE courses.

5.1 Regression Results by Race/Ethnicity

Table 4 displays regression results by race/ethnicity for six short-term outcomes and three longer-term outcomes. Each column in each panel represents the results of a separate regression. Panel A presents regression results for Black students, Panel B for Hispanic students, and Panel C for White students. The reference group is non-DE students in each racial/ethnic group. We control for students' gender, birth month and year, LEP status, FRPL status, and grade 9 grades and credits attempted. We also include high school and cohort fixed effects to take into account any specific confounding effects common to each high school and cohort.

Overall, DE is associated with positive college outcomes for Black, Hispanic, and White students. All of the college outcome coefficients are positive (and statistically significant) except for immediate state college enrollment, which is negative (but small) for Black and Hispanic students. Aside from the immediate state college and state university enrollment outcomes, the magnitudes of the DE effects are slightly larger for White students than for Black and Hispanic students. It is worth noting that the college outcome coefficients for Black and Hispanic students are similar to one another, although Black students were significantly more likely to transfer to a state university (column 9).

DE is associated with a 13.9 percentage point increase in the probability of college enrollment for White students and a 9.8 and 8.6 percentage point increase for Black and Hispanic students, respectively. White students who took DE courses were more likely than their White non-DE peers to enroll in a state college or university after graduating from high school, while Black and Hispanic DE students were less likely than their same-group non-DE peers to enroll in a state college and more likely to enroll in a state university. DE thus diverts Black and Hispanic students away from immediate state college enrollment and toward enrollment in state universities.

To further explain this finding, we conduct a supplemental analysis looking at the high school characteristics of DE students by race/ethnicity (see Table 5). Using Common Core data, we find that Black DE students were much more likely than White DE students to attend high schools located in urban areas where universities are located.

The proximity to a university may explain at least partly why Black DE students were more likely to attend a state university than a state college after high school. Finally, White DE students had a slightly higher rate of immediate full-time enrollment and fall-to-spring persistence than Black and Hispanic DE students.

Additionally, we followed the 2007 cohort of Florida ninth-graders for six years after high school to examine the effects of DE on degree completion outcomes. DE had similar positive effects on bachelor's degree completion rates within six years for Black, Hispanic, and White students, but DE is associated with much larger gains in associate degree completion rates for White students (14.3 percentage points) than for Black and Hispanic students (9.2 and 6.5 percentage points). DE is also associated with much a larger upward transfer rate from state colleges to universities for White students than for Black and Hispanic students.

5.2 Regression Results by Dual Enrollment Course Modality

Table 6 presents the regression results by the primary modality through which students took DE courses. In addition to the variables included in the regressions for Table 4, we also control for students' race/ethnicity. Each column represents a separate regression with non-DE students as the reference group.

Overall, DE is positively correlated with immediate college enrollment regardless of primary modality. Students who primarily took DE courses face-to-face (on or off a college campus) experienced slightly larger gains than those who primarily took DE online. Taking most DE courses face-to-face off-campus is associated with a 13.7 percentage point increase in the chance of going to college immediately after high school graduation, and taking DE courses primarily face-to-face on campus is associated with a 15.3 percentage point increase in the chance of immediate college enrollment. Taking DE courses primarily online is associated with an 11.6 percentage point increase in the chance of immediate college enrollment.⁹

⁹ One possible explanation for the differential effects of DE by modality is that the types of courses offered online might be different from those offered face-to-face. To explore this possibility, Table 7 presents the distribution of course subjects by the three groups of DE students examined in terms of modality (i.e., students who took DE primarily online, primarily face-to-face on-campus, and primarily face-to-face off-campus) and race/ethnicity. Overall, English composition and mathematics (i.e., calculus, pre-calculus, algebra, and statistics) were the main course subjects taken by DE students, regardless of modality. Yet,

DE has an overall positive association with immediate state university enrollment, regardless of primary modality, and a much smaller association with immediate state college enrollment, regardless of primary modality. The gains in immediate state university enrollment were 11.3, 11.9, and 12.1 percentage points for face-to-face on-campus, face-to-face off-campus, and online DE, respectively. In contrast, taking DE courses primarily face-to-face off-campus is associated with a 2.1 percentage point increase in immediate state college enrollment, and taking DE courses primarily face-to-face on-campus is associated with a 4.3 percentage point increase in this outcome. Taking DE courses primarily online is not associated with a better chance of immediate state college enrollment.

The effects of DE on immediate full-time enrollment and fall-to-spring persistence are similar across modalities, with slightly stronger effects for students who took most of their DE credits face-to-face. Taking DE primarily face-to-face on-campus, face-to-face off-campus, and online are all positively associated with immediate full-time enrollment (13.6, 11.8, and 10.7 percentage points, respectively). The gap between DE participants and non-participants in persistence rates is most pronounced for students who took DE primarily face-to-face on-campus (a 15.3 percentage point increase), followed by those who took DE primarily face-to-face off-campus (a 13.9 percentage point increase), and those who took DE courses primarily online (an 11.0 percentage point increase).

5.3 Regression Results by Race/Ethnicity and Dual Enrollment Course Modality

Finally, Table 8 examines the effects of DE by race/ethnicity and course modality; effects for Black students are in Panel A, those for Hispanic students are in Panel B, and those for White students are in Panel C. We ran the same regressions as we did in Table 6 for the three racial/ethnic groups, comparing DE students of different primary modalities in each racial/ethnic group to their non-DE counterparts of the same

compared to the other two groups, students who took their DE courses primarily online enrolled less often in English, math, and other STEM-related fields, and more often in (non-English) humanities and social sciences. An interesting direction for future analysis would be to conduct robustness checks that include subject-bundle fixed effects that only compare across students who take similar bundles of DE courses, such as two math courses and one English course.

race/ethnicity. The analysis sheds light on some interesting patterns. While all students gained from each DE modality, the strength of gains for each modality varies somewhat across groups, with Black students having better outcomes in online DE and Hispanic and White students having better outcomes in face-to-face DE. Black students who took DE courses primarily online had slightly more desirable outcomes among Black DE students across all modalities. Hispanic students who took DE courses primarily face-to-face on-campus had the most desirable outcomes among Hispanic DE students. And similarly, White students who took DE courses primarily face-to-face on-campus had slightly better outcomes among White DE students.

Compared to Black students who took DE courses through other modalities, Black students who primarily took DE online gained the most in terms of likelihood of immediate college enrollment (18.0 percentage points) though the differences were modest. This gain was mostly driven by the increase in the chance of immediate state university enrollment (23.5 percentage points). Taking a majority of DE courses online is also associated with a higher rate of immediate full-time enrollment (20.0 percentage points) and persistence from fall to spring (17.0 percentage points) among Black students.

Across most college outcomes, Hispanic students gained the most by taking the majority of their DE courses face-to-face on-campus. Hispanic students who took most of their DE courses face-to-face on-campus had a 14.0 percentage point greater likelihood of immediate college enrollment, a 16.3 percentage point greater likelihood of immediate state university enrollment, a 12.2 percentage point greater likelihood of immediate full-time enrollment, and a 14.5 percentage point greater likelihood of persistence from fall to spring. Across most college outcomes, White DE students also had the most to gain by taking the majority of their courses face-to-face on-campus. (Such students had a 15.6 percentage point greater likelihood of immediate college enrollment, an 8.5 percentage point greater likelihood of immediate state university enrollment, an 11.2 percentage point greater likelihood of immediate full-time enrollment, and a 15.5 percentage point greater likelihood of persistence from fall to spring.)

Across modalities, the most striking difference in within-group college outcomes between White and Black and White and Hispanic DE students is in immediate enrollment in a state college. While Black and Hispanic students gained much more in

terms of likelihood of immediate state university enrollment versus state college enrollment, the difference in gains for these two outcomes among White students was modest. This pattern is consistent with our findings analyzed by racial/ethnic group alone in Table 4.

6. Discussion and Conclusion

In this study, we use longitudinal data on two cohorts of students who were ninth graders in Florida public schools in 2007 and 2012 to conduct a descriptive analysis of DE student characteristics and outcomes and to conduct multivariate regression analysis of the effects of taking DE courses on short- and long-term outcomes. We examine characteristics and outcomes using three student racial/ethnic groups (Black, Hispanic, and White) and three DE course modalities (face-to-face on-college-campus, face-to-face off-campus, and online). We use administrative data from the Florida Department of Education to carry out the analyses, which include information on student characteristics, course-taking behaviors, and college outcomes. It is important to reiterate that although we control for a rich set of student demographic and academic performance characteristics as well as school characteristics in our multivariate regressions, the methods we use to estimate our results do not account for some unobserved factors and therefore do not allow for causal inferences. Below we summarize the key findings.

- *DE participation.* Florida high school students who took DE courses were more likely to be White, female, and from more affluent backgrounds than those who did not take DE courses.
- *DE effects on outcomes by race/ethnicity.* Taking DE courses is positively associated with college outcomes, including immediate college enrollment and degree completion, across all three racial/ethnic groups. However, compared with same-group students who did not take any DE courses, White DE students were more likely to attend both state colleges (community colleges) and universities, whereas Black and Hispanic DE students were more likely to attend state universities and (slightly) less likely to attend state colleges than their non-DE peers.

- *DE effects on outcomes by course modality.* Taking DE courses is positively associated with college outcomes, regardless of the primary course-taking modality. Across most outcomes, students who primarily took DE courses face-to-face (on or off a college campus) had slightly better outcomes than those who primarily took DE courses online. (But Black students who took DE primarily online had slightly stronger outcomes than those who did so face-to-face.)

These findings lead to the following general conclusions about DE in Florida: (1) there are participation gaps in DE course-taking among students by race/ethnicity, family income, and gender; (2) taking DE courses is associated with better college outcomes for all racial/ethnic groups considered (Black, Hispanic, and White students); and (3) the effects of DE are similar across course modality, although taking courses online is associated with slightly smaller benefits than taking courses face-to-face.

From an equity perspective, our results concerning greater university enrollment among Black and Hispanic DE students suggest that DE may be a helpful tool in narrowing the gap between Black and White university enrollment. DE participation may influence the educational aspirations of non-White students to attend a university instead of a state college (community college). This may be a result of early exposure to college information and norms, the lack of which is cited as one of the major reasons why students of color and low-income students are more likely than peers of similar academic standing to choose less selective colleges or not attend at all (Fry & Cilluffo, 2019; Hoxby & Avery, 2012). With these findings in mind, high schools should encourage more students of color and low-income students to participate in DE. Students underrepresented in DE may face challenges such as poor K-8 preparation and lack of information and adequate advising, which typical DE students may face less often. It is worth further investigating what is preventing underrepresented students from participating in DE. Strategies such as targeted outreach and recruitment, as well as free transportation, may help broaden access to such students.

This study also shows that while DE course modality matters, the differences in magnitudes are modest. Although the benefits associated with online DE courses for White and Hispanic students are not as sizable as those associated with face-to-face DE coursework that is delivered on a college campus or in a local high school, the online

learning format has the potential to expand access to DE programs among students who have limited access to face-to-face DE opportunities. Indeed, school districts and colleges could work together to design strategies to further improve the learning gains associated with online DE coursework and ensure that all DE students are well-supported to succeed in courses taken online.

This report also leaves some important unanswered questions. First, our supplemental analysis found that students from particular racial/ethnic groups and those who were more likely to use particular DE course modalities come from different kinds of high schools. Future research can look at whether the location, type, or student composition of the high school affects the DE experience and how DE participation affects student outcomes. Second, we are unable to distinguish the various off-campus DE learning locations (e.g., high school versus community college branch campus) in the available data; it would be interesting to examine course-taking patterns across different campuses and the heterogeneity of DE effects by more specific modalities. Other questions worth examining include: What faculty, course, and peer characteristics contribute to the differential DE effects across modalities? What modality do DE students prefer, and how do students' background, high school characteristics, and guidance from counselors shape their preferences?

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Tables

Table 1. Student Characteristics and Descriptive Outcomes by Race/Ethnicity

	(1) All DE students	(2) All non-DE students	(3) Black DE students	(4) Black non-DE students	(5) Hispanic DE students	(6) Hispanic non- DE students	(7) White DE students	(8) White non- DE students
<i>Observations for 2007 & 2012 cohorts</i>	40,616	230,073	6,456	52,139	7,418	61,975	24,145	103,653
Demographic characteristics								
Female	61%	48%	65%	51%	62%	49%	60%	47%
Free or reduced-price lunch	37%	55%	68%	78%	64%	73%	21%	34%
Limited English Proficiency students	13%	21%	9%	13%	48%	57%	2%	3%
Grade 9 GPA	3.4	2.7	3.1	2.5	3.3	2.6	3.4	2.8
Grade 9 credits attempted	7.6	7.7	7.6	7.9	7.4	7.4	7.7	7.8
1-year outcomes (2007 & 2012 cohorts)								
Graduated from high school	99%	94%	99%	93%	99%	92%	99%	94%
Immediate college enrollment	68%	44%	55%	37%	68%	45%	72%	46%
Immediate college enrollment in a state university	37%	14%	28%	9%	33%	10%	40%	17%
Immediate college enrollment in a state college	32%	30%	27%	28%	35%	35%	32%	28%
Immediate full-time college enrollment	58%	33%	44%	25%	57%	33%	62%	36%
Persistence from fall to spring	65%	40%	51%	33%	65%	40%	68%	41%
Longer-term outcomes (2007 cohort only)								
<i>Observations for 2007 cohorts</i>	15,243	115,823	2,030	26,562	2,106	29,516	10,079	52,503
Bachelor's degree within 6 years of college enrollment	42%	15%	32%	8%	37%	12%	45%	18%
Associate degree within 3 years of college enrollment	29%	12%	23%	8%	27%	14%	31%	12%
Transferred to a state university	17%	10%	13%	7%	18%	12%	18%	9%

Table 2. Student Characteristics and Descriptive Outcomes by Dual Enrollment Course Modality

	(1) All DE students	(2) Attempted > 50% DE credits online	(3) Attempted > 50% DE credits on-college campus face-to- face	(4) Attempted > 50% DE credits off-college campus face-to- face
<i>Observations (2012 cohort)</i>	18,700	1,667	9,202	7,452
Demographic Characteristics				
Female	63%	64%	65%	60%
White	64%	64%	64%	64%
Black	13%	11%	10%	16%
Hispanics	16%	17%	19%	14%
Asian	6%	7%	6%	6%
Other races	0%	1%	0%	0%
Free or reduced-price lunch	37%	37%	38%	37%
LEP students	9%	8%	10%	9%
Grade 9 GPA	3.46	3.55	3.47	3.43
Grade 9 credits attempted	7.19	7.44	7.27	7.03
Course-taking pattern				
Total DE online credits attempted	2.20	10.65	1.91	0.37
% of DE credits taken online	11%	74%	6%	2%
Total DE on-campus face-to-face credits attempted	9.14	3.34	16.88	0.82
% of DE credits taken on campus face-to-face	49%	18%	91%	5%
Total DE off-campus face-to-face credits attempted	4.03	1.33	0.75	8.45
% of DE credits taken on campus face-to-face	40%	8%	3%	93%
1-year Outcomes (2012 Cohorts)				
Graduated from high school	99%	99%	99%	99%
Immediate college enrollment	72%	71%	75%	67%
Immediate college enrollment in a state university	39%	41%	40%	38%
Immediate college enrollment in a state college	33%	30%	36%	29%
Immediate full-time college enrollment	60%	60%	61%	58%
Persistence from fall to spring	68%	67%	71%	64%

Note: 379 students in the 2012 cohort have missing modality data.

Table 3. Student Characteristics and Descriptive Outcomes by Race/Ethnicity and Dual Enrollment Course Modality

	Attempted > 50% DE credits online			Attempted > 50% DE credits on-college campus face-to-face			Attempted > 50% DE credits off-college campus face-to-face			
	All	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic	White
<i>Observations (2012 cohort)</i>	18,700	181	283	807	962	1,725	6,969	1,186	1,022	4,803
Demographic characteristics										
Female	63%	66%	64%	63%	71%	65%	64%	67%	62%	58%
Free or reduced-price lunch	64%	63%	59%	27%	65%	62%	26%	71%	62%	24%
LEP students	13%	9%	30%	1%	9%	37%	2%	9%	37%	2%
Grade 9 GPA	3.5	3.4	3.5	3.6	3.4	3.4	3.5	3.2	3.4	3.5
Grade 9 credits attempted	7.2	7.6	7.4	7.5	7.5	7.3	7.3	7.2	7.2	7.0
Course-taking pattern										
Total DE online credits attempted	2.2	9.4	9.9	12.4	1.7	1.8	3.4	0.2	0.4	0.7
% of DE credits taken online	11%	75%	74%	83%	6%	6%	16%	1%	2%	5%
Total DE on-campus face-to-face credits attempted	9.1	3.2	3.1	3.0	14.7	16.7	15.6	0.5	1.0	0.7
% of DE credits taken on-campus face-to-face	49%	15%	18%	12%	91%	92%	80%	4%	5%	4%
Total DE off-campus face-to-face credits attempted	4.0	1.3	1.1	1.3	0.6	0.6	1.1	6.0	8.5	8.9
% of DE credits taken on-campus face-to-face	40%	10%	8%	6%	3%	2%	4%	95%	93%	91%
1-year outcomes (2012 Cohorts)										
Graduated from high school	99%	99%	99%	99%	99%	99%	99%	99%	100%	99%
Immediate college enrollment	72%	72%	72%	71%	71%	77%	74%	55%	70%	68%
Immediate college enrollment in a state university	43%	46%	43%	40%	41%	40%	39%	28%	34%	41%
Immediate college enrollment in a state college	29%	28%	29%	31%	31%	38%	36%	28%	36%	28%
Immediate full-time college enrollment	59%	63%	59%	60%	59%	62%	61%	44%	58%	60%
Persistence from fall to spring	68%	68%	68%	66%	67%	74%	70%	52%	66%	65%

Note: 847 DE students are Asian and native Americans or Alaska natives, and 379 students have missing modality data for the 2012 cohort.

Table 4. Regression Effects by Race/Ethnicity

Outcomes	(1) Graduated from high school	(2) Immediate college enrollment	(3) Immediate state university enrollment	(4) Immediate state college enrollment	(5) Immediate full-time enrollment	(6) Persistence from fall to spring	(7) Bachelor's degree in 6 years	(8) Associate degree in 3 years	(9) Transfer from college to university
Panel A: Black students only									
Ever DE in grade 11/12	0.006* (0.004)	0.098*** (0.007)	0.121*** (0.004)	-0.021*** (0.007)	0.105*** (0.006)	0.102*** (0.007)	0.147*** (0.007)	0.092*** (0.007)	0.034*** (0.006)
Observations	58,515	58,515	58,515	58,515	58,515	58,515	28,525	28,525	28,525
R-squared	0.097	0.143	0.186	0.046	0.155	0.156	0.173	0.092	0.055
Cohort	both	both	both	both	both	both	2007	2007	2007
Panel B: Hispanics students only									
Ever DE in grade 11/12	-0.011*** (0.003)	0.086*** (0.006)	0.115*** (0.004)	-0.027*** (0.006)	0.094*** (0.006)	0.093*** (0.006)	0.126*** (0.008)	0.065*** (0.008)	0.012 (0.008)
Observations	69,350	69,350	69,350	69,350	69,350	69,350	31,574	31,574	31,574
R-squared	0.115	0.165	0.207	0.052	0.171	0.179	0.185	0.075	0.053
Cohort	both	both	both	both	both	both	2007	2007	2007
Panel C: White students only									
Ever DE in grade 11/12	-0.001 (0.002)	0.139*** (0.004)	0.098*** (0.003)	0.042*** (0.004)	0.127*** (0.004)	0.140*** (0.004)	0.146*** (0.004)	0.143*** (0.004)	0.070*** (0.004)
Observations	127,736	127,736	127,736	127,736	127,736	127,736	62,526	62,526	62,526
R-squared	0.088	0.172	0.244	0.038	0.191	0.19	0.238	0.073	0.038
Cohort	both	both	both	both	both	both	2007	2007	2007

Note. Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. All regressions control for students' gender, race/ethnicity, birth month and year, LEP status, FRPL status, grade 9 grades, grade 9 credits attempted, as well as high school and cohort fixed effects.

Table 5. High School Characteristics of Dual Enrollment Students by Race/Ethnicity

	All DE students	Black DE students	Hispanic DE students	White DE students
Location:				
Urban	29%	52%	25%	22%
Suburb	49%	36%	48%	62%
Town	16%	8%	20%	12%
Rural	6%	3%	7%	4%
Student teacher ratio	19	19	19	20
Title 1 eligible	46%	70%	35%	62%
Magnet School	32%	50%	23%	43%
Charter School	4%	3%	3%	8%
Percent free & reduced lunch students	40%	50%	34%	51%
Distance to nearest postsecondary institution (miles)	5.4	3.7	6.3	4.3
Observations merged with Common Core data	39,944	6,348	23,741	7,324

Note: DE students are merged to the Common Core data through their ninth-grade high school name and address.

Table 6. Regression Effects by Dual Enrollment Course Modality

	(1)	(2)	(3)	(4)	(5)	(6)
Outcomes	Graduated from high school	Immediate college enrollment	Immediate state university enrollment	Immediate state college enrollment	Immediate full-time enrollment	Persistence from fall to spring
> 50% DE credits taken face-to-face off-campus	-0.003 (0.003)	0.137*** (0.006)	0.119*** (0.005)	0.021*** (0.006)	0.136*** (0.006)	0.139*** (0.006)
> 50% of DE credits taken face-to-face on-campus	-0.010*** (0.003)	0.153*** (0.005)	0.113*** (0.004)	0.043*** (0.005)	0.118*** (0.005)	0.153*** (0.005)
> 50% of DE credits taken online	-0.017*** (0.005)	0.116*** (0.012)	0.121*** (0.008)	0.001 (0.012)	0.107*** (0.011)	0.110*** (0.011)
Observations	132,903	132,903	132,903	132,903	132,903	132,903
R-squared	0.106	0.172	0.245	0.041	0.188	0.190
Cohort	2012	2012	2012	2012	2012	2012

Note. Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. All regressions control for students' gender, race/ethnicity, birth month and year, LEP status, FRPL status, grade 9 grades, grade 9 credits attempted, as well as high school and cohort fixed effects.

Table 7. Distribution of Courses by Dual Enrollment Course Modality and Race/Ethnicity

Course Subject	Attempted > 50% DE credits online				Attempted > 50% DE credits on-college campus face-to-face				Attempted > 50% DE credits off-college campus face-to-face			
	All	Hispanic	Black	White	All	Hispanic	Black	White	All	Hispanic	Black	White
English Composition	16%	17%	19%	16%	19%	18%	20%	19%	30%	33%	25%	30%
Mathematics	9%	8%	8%	9%	15%	14%	15%	15%	17%	14%	11%	18%
Statistics	2%	2%	1%	2%	2%	2%	2%	3%	4%	3%	3%	4%
Biological Sciences	3%	3%	3%	4%	8%	7%	8%	8%	7%	6%	6%	7%
Chemistry	1%	1%	0%	1%	3%	2%	2%	3%	0%	0%	0%	0%
Computer General Studies	4%	4%	5%	3%	2%	2%	2%	2%	1%	2%	2%	1%
Economics	6%	8%	5%	6%	4%	4%	3%	4%	0%	1%	0%	0%
American History	5%	4%	5%	5%	5%	5%	5%	6%	8%	9%	6%	8%
Speech Communication	3%	3%	3%	2%	5%	6%	6%	5%	1%	1%	0%	1%
Political Science	6%	8%	5%	6%	4%	5%	4%	4%	3%	3%	2%	3%
Psychology	5%	4%	6%	5%	4%	4%	4%	4%	1%	2%	2%	1%
Humanities	5%	3%	4%	5%	4%	5%	3%	3%	2%	3%	2%	3%
Student Life Skills	4%	2%	3%	4%	4%	3%	5%	3%	10%	8%	29%	7%
Philosophy	2%	3%	3%	2%	2%	2%	2%	2%	0%	0%	0%	0%
Sociology	3%	5%	4%	3%	2%	2%	2%	2%	0%	1%	0%	0%
Developmental Psychology	3%	3%	4%	3%	1%	2%	1%	1%	0%	0%	0%	0%
Religion Undergraduate	2%	2%	2%	1%	1%	1%	1%	1%	0%	1%	0%	0%
Other	23%	20%	20%	23%	15%	16%	14%	15%	15%	14%	13%	16%

Note: Course subjects with a student participation rate of less than 1% in at least one of the DE modalities were included in “Other.”

Table 8. Regression Effects by Race/Ethnicity and Dual Enrollment Course Modality

Outcomes	(1) Graduated from high school	(2) Immediate college enrollment	(3) Immediate state university enrollment	(4) Immediate state college enrollment	(5) Immediate full- time enrollment	(6) Persistence from fall to spring
Panel A: Black students only						
> 50% DE credits taken face-to-face off- campus	0.012 (0.008)	0.131*** (0.015)	0.115*** (0.009)	0.019 (0.015)	0.112*** (0.014)	0.128*** (0.015)
>50% of DE credits taken face-to-face on-campus	-0.020** (0.008)	0.160*** (0.016)	0.191*** (0.010)	-0.026* (0.016)	0.165*** (0.014)	0.165*** (0.015)
>50% of DE credits taken online	-0.013 (0.018)	0.180*** (0.035)	0.235*** (0.021)	-0.037 (0.034)	0.200*** (0.031)	0.170*** (0.033)
Observations	27,881	27,881	27,881	27,881	27,881	27,881
R-squared	0.111	0.165	0.201	0.063	0.172	0.179
HS FE	Y	Y	Y	Y	Y	Y
Cohort	2012	2012	2012	2012	2012	2012
Panel B: Hispanic students only						
> 50% DE credits taken face-to-face off- campus	-0.020** (0.008)	0.137*** (0.016)	0.125*** (0.010)	0.015 (0.016)	0.141*** (0.015)	0.140*** (0.016)
>50% of DE credits taken face-to-face on-campus	-0.024*** (0.006)	0.140*** (0.012)	0.163*** (0.008)	-0.020 (0.013)	0.122*** (0.012)	0.145*** (0.012)
>50% of DE credits taken online	-0.036** (0.015)	0.117*** (0.028)	0.194*** (0.018)	-0.071** (0.029)	0.108*** (0.027)	0.114*** (0.028)
Observations	35,507	35,507	35,507	35,507	35,507	35,507
R-squared	0.135	0.177	0.235	0.057	0.184	0.194
HS FE	Y	Y	Y	Y	Y	Y
Cohort	2012	2012	2012	2012	2012	2012

Note. Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. All regressions control for students' gender, race/ethnicity, birth month and year, LEP status, FRPL status, grade 9 grades, grade 9 credits attempted, as well as high school and cohort fixed effects.

Table 8 (continued). Regression Effects by Race/Ethnicity and Dual Enrollment Course Modality

	(1)	(2)	(3)	(4)	(5)	(6)
Outcomes	Graduated from high school	Immediate college enrollment	Immediate state university enrollment	Immediate state college enrollment	Immediate full-time enrollment	Persistence from fall to spring
Panel C: White students only						
> 50% DE credits taken face-to-face off-campus	-0.001 (0.003)	0.137*** (0.008)	0.112*** (0.006)	0.028*** (0.008)	0.141*** (0.008)	0.140*** (0.008)
>50% of DE credits taken face-to-face on-campus	-0.003 (0.003)	0.156*** (0.007)	0.085*** (0.005)	0.073*** (0.007)	0.112*** (0.007)	0.155*** (0.007)
>50% of DE credits taken online	-0.010 (0.006)	0.118*** (0.015)	0.084*** (0.011)	0.037*** (0.014)	0.099*** (0.014)	0.109*** (0.014)
Observations	63,150	63,150	63,150	63,150	63,150	63,150
R-squared	0.097	0.179	0.251	0.043	0.192	0.197
HS FE	Y	Y	Y	Y	Y	Y
Cohort	2012	2012	2012	2012	2012	2012

Note. Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$. All regressions control for students' gender, race/ethnicity, birth month and year, LEP status, FRPL status, grade 9 grades, grade 9 credits attempted, as well as high school and cohort fixed effects.