1-1-2021

Does Delivery Location Matter? A National Study of the Impact of Early Dual Enrollment on College Readiness and First-Year Academic Momentum

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Original Citation

Hu, Xiaodan; Chan, Hsun-Yu. "Does Delivery Location Matter? A National Study of the Impact of Early Dual Enrollment on College Readiness and First-Year Academic Momentum", Teachers College Record, Volume 123 Number 4, 2021, https://www.tcrecord.org ID Number: 23657

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Description of the article

This study examines whether the delivery location of dual enrollment impacts students' college preparation and first-year academic momentum in college. Using inverse probability weighted regression adjustments to estimate the treatment effects, we find that taking DE course(s) on a college campus largely does not contribute to students' college readiness and accumulation of academic momentum, when compared with their peers who took DE course(s) elsewhere.

Abstract

Background/Context: While dual enrollment (DE) programs have indicated positive impact on various high school and postsecondary outcomes, access to DE programs remains to be unequal that historically marginalized students are less likely to attempt college credits in high school. Despite DE being a widely adopted program at the state level, these programs vary greatly by eligibility criteria, funding models, delivery location and modality.

Purpose/Objective/Research Question/Focus of Study: Guided by prominent learning theories, we hypothesize that the influence of early DE on later educational pathways and outcomes may vary by the location in which DE is delivered. This study examines whether the delivery location of DE (i.e., on a college campus or otherwise) influences students' college readiness and first-year academic momentum in college, with a special focus on its heterogeneous effect among students of diverse racial and socioeconomic background.

Research Design: Using the restricted-use data from High School Longitudinal Study of 2009 (HSLS:09), we use a quasi-experimental approach (i.e., inverse probability weighting models) with a nationally represented sample of students who have taken at least one DE course by 11th grade.

Findings/Results: The findings reveal that students who took at least one DE course on a college campus do not differ in their cumulative high school GPA, probability of attending college, whether taking developmental courses, whether attending college immediately after high school graduation, and probability of full-time enrollment, when compared with who took DE course(s) elsewhere. However, the findings are not applicable to all students of varying background defined by race/ethnicity and socioeconomic status.

Conclusions/Recommendations: This study provides several implications: 1) Since DE course taken on a high school or college campus equally fuel students' college readiness and early academic momentum, advising practices should acknowledge the benefits of DE courses regardless of delivery location. 2) DE participation with college exposure may in particular benefit students with higher socioeconomic status (SES), so interventions which offers holistic college experiences beyond academic work are needed to effectively prepare lower SES student for college life and accumulate academic momentum. 3) States and educational entities should be mindful about the potential disparate effect of DE programs, ensuring their regulation, oversight, and quality assurance in DE programs can narrow the postsecondary achievement gap.

Keywords: dual enrollment, college readiness, early academic momentum, inverse probability weighting

Executive Summary

Dual enrollment (DE), also known as *dual credit* and *concurrent enrollment*, refers to high school students enrolling in college courses for both secondary and postsecondary credits. Over the years, DE programs have gained increasing popularity among high school students that a third of high school students took at least one DE course. While DE programs have indicated positive impact on various high school and postsecondary outcomes, access to DE programs remains to be unequal that historically marginalized students are less likely to attempt college credits in high school. Despite DE being a widely adopted program at the state level, these programs vary greatly by eligibility criteria, funding models, delivery location and modality.

Purpose

One of the most drastic differences between DE types lies in the location where DE is delivered, and critics are concerned over the rigor of instruction, instructors' credential, and the lack of college exposure for students taking DE at high school or online. While policies at different levels are in place to ensure high quality of DE courses delivered in the high school setting, high school teachers believe they are as rigorous as DE courses delivered in the college setting. Prominent learning theories, however, highlighted the impact of the environment and institutional agents' cultural background on the learning activities and even outcomes, implying that the influence of DE on later educational pathways and outcomes may vary by the location in which DE is delivered.

Additionally, students' access to DE programs is unequal that historically marginalized student populations, such as students that are economically and racially minoritized, are less likely to attempt college credits in high school. It remains unclear whether DE's delivery location would influence students' subsequent educational pathway and what it means for postsecondary access and equity. Given these dynamics, this study examines whether the delivery location of DE (i.e., on a college campus or otherwise) influences students' college readiness and first-year academic momentum in college, with a special focus on its heterogeneous effect among students of diverse racial and socioeconomic background

Research Design

Data Source and Sample. Using the nationally represented data from High School Longitudinal Study of 2009 (HSLS:09), we restricted our sample to 3,920 students (unweighted) who have taken at least one DE course by 11th grade. In order to examine the heterogeneous effects of DE location on student performance, we created four subgroups based on student's race and socioeconomic status (SES).

Variables. We included five dependent variables that measure a student's college readiness and first-year academic momentum, including high school GPA for academic courses, college attendance, developmental education, delayed enrollment, and full-time enrollment status. The treatment variable is the location of early DE course(s) taken as of 11th grade, which was dummy coded as 0 if taking no DE course on a college campus, 1 if they have taken at least one DE course on a college campus as of 11th grade. In line with our literature review, we controlled for pre-treatment covariates measured at 9th grade (e.g., students' demographic characteristics,

motivational attributes, GPA) and post-treatment covariates (e.g., the highest level math course taken by the 12th grade, the number of earned AP and IB credits).

Addressing Selection Bias. Choosing whether to take DE courses on a college campus can be subject to factors such as students' pre-existing differences as opposed to the treatment (e.g., individual preferences, distance to a college campus). To reduce selection bias between the treated group and control group, we utilized inverse probability weighting (IPW) models to ensure overlap and comparability between the treated groups and the control group. Specifically, we used logistic regression to estimate the propensity score p for each observation based on treatment probabilities controlling for pre-treatment covariates. The same procedure was repeated to estimate a set of average treatment effect on the treated (ATT) weights for the full sample, college-attending sample, and SES and racial/ethnic group subsamples respectively. Essentially, the IPW procedures successfully reduced selection bias that students in the treated group and the control group have a statistically equivalent likelihood to take DE course(s) on a college campus as of their 11th grade.

Analytic Strategies. To estimate the influence of location of early DE course-taking on the outcomes, we used a series of linear and logistic regression models that control for the pre- and post-treatment variables. To address the differences in DE availability at each high school and contextual characteristics, high school fixed effects were controlled for in all models by specifying the primary sampling unit and strata.

Key Findings

1. Students who took at least one DE course on a college campus do not differ in their cumulative high school GPA, probability of attending college, whether taking developmental courses, whether attending college immediately after high school graduation, and probability of full-time enrollment, when compared with students who took DE course(s) elsewhere.
2. Within subgroups defined by race/ethnicity, the delivery location of early DE course(s) largely does not contribute to variations in students' college readiness and the accumulation of academic momentum.
3. In contrast, students with higher SES background who took at least one DE course on a college campus are more likely to have higher high school GPA and less likely to take developmental classes once enrolled in college, when compared with their peers who took DE course(s) elsewhere. College students with lower SES background who took at least one DE course on a college campus are less likely to enrolled full-time, when compared with their peers who took DE course(s) elsewhere.

Recommendations

1. Since DE course taken on a high school or college campus equally fuel students' college readiness and early academic momentum, advising practices should acknowledge the benefits of DE courses regardless of delivery location.
2. Resources should continue to be allocated to DE programs in different settings to provide all students access to college-level courses. Especially for school districts that are not adjacent to a college, their capacity to offer DE programs can critically support students' postsecondary success.

3. DE participation with college exposure may in particular benefit students with higher SES, so interventions which offers holistic college experiences beyond academic work to effectively prepare lower SES student for college life and accumulate academic momentum.
4. States and educational entities should be mindful about the potential disparate effect of DE programs, ensuring their regulation, oversight, and quality assurance in DE programs can narrow the postsecondary achievement gap.
5. Since DE programs are highly localized, future research can use datasets with district- and college-level curriculum information, coupled by a cross-examination of college transcript record, to provide updated local implications. Similarly, the quality of DE program may vary in terms of inspiring students for postsecondary education or preparing students for a stronger early academic momentum after entering college. Future studies can employ a critical perspective to understand the intersection of students' social identities, challenge the current DE mechanism, and reshape DE programs to empower participating students that are racially and economically minoritized.

Does Delivery Location Matter? A National Study of the Impact of Early Dual Enrollment on College Readiness and First-Year Academic Momentum

Dual enrollment (DE), also known as *dual credit* and *concurrent enrollment*, refers to high school students enrolling in college courses for both secondary and postsecondary credits (An & Taylor, 2019). Over the years, DE programs have gained increasing popularity among high school students (Hofmann, 2012). According to the U.S. Department of Education (2019), a third of high school students took at least one DE course. During the 2010 school year, 82% of public high schools and 46% of postsecondary institutions reported high school students taking DE courses on their campus (Marken et al., 2013; Thomas et al., 2013). DE programs have indicated positive impact on various high school and postsecondary outcomes (Allen & Dadgar, 2012; An, 2013a, 2013b, 2015; An & Taylor, 2015; Cowan & Goldhaber, 2015; Grubb et al., 2017; Phelps & Chan, 2016; Taylor, 2015; U.S. Department of Education, 2017).

One of the most drastic differences between DE types lies in the location where DE is delivered, and critics are concerned over the rigor of instruction, instructors' credential, and the lack of college exposure for students taking DE at high school or online (An & Taylor, 2019; Burns & Lewis, 2000; Horn et al., 2018). While policies at different levels are in place to ensure high quality of DE courses delivered in the high school setting, high school teachers believe they are as rigorous as DE courses delivered in the college setting (Ferguson et al., 2015; Zinth, 2015). Prominent learning theories, however, highlighted the impact of the environment and institutional agents' cultural background on the learning activities and even outcomes (Bronfenbrenner, 1995; Gutiérrez & Rogoff, 2003), implying that the influence of DE on later educational pathways and outcomes may vary by the location in which DE is delivered. Though several studies examined the impact of delivery location of DE on students' educational aspiration, college persistence, and completion (D'Amico et al., 2013; Phelps & Chan, 2016; Smith, 2007; Speroni, 2011), the findings are largely mixed and few controlled for the selection bias of students choosing different DE delivery locations.

Students' access to DE programs is unequal that historically marginalized student populations, such as students that are economically and racially minoritized, are less likely to attempt college credits in high school (Museus et al., 2007; Zinth & Barnett, 2018). The causes start at access: Recent statistics maintain that school districts enrolling more low-income students and located in the urban area are less likely to offer DE programs at all (U.S. Department of Education, 2020). Even among dually enrolled students, taking DE classes on a college campus is not a viable option to students that reside in *education deserts* or do not have reliable transportation to a college nearby (Hillman, 2018, p. 127; Zinth, 2015). It remains unclear whether DE's delivery location would influence students' subsequent educational pathway and what it means for postsecondary access and equity. Given these dynamics, this study examines the impact of DE by exploring the following overarching research questions: *To what extent does the delivery locations of early DE course* influence *students' college readiness and first-year academic momentum? Does the* influence *vary by student racial and socioeconomic groups?*

Literature Review

Dual enrollment has been in place at the state level for many decades. As of 2016, 47 states have one or more common statewide DE policies, except Alaska, New Hampshire, and New York (Education Commission of the States [ECS], 2019). Given the varying regulations of DE programs, previous reports have focused on the role of state coordinating or governing agencies and analyzed the different components of DE policies at the state level (Borden et al., 2013; Hoffman et al., 2008; Zinth, 2014). While a comprehensive and in-depth literature review of DE has been conducted by Allen (2010) and An and Taylor (2019), we reviewed recently published studies on DE and highlighted the variation of DE regarding its delivery location with a focus on the role DE programs plays in postsecondary access and equity.

The National Landscape of Dual Enrollment

Among the 47 states with statewide DE policy, 41 states specified that at least one or more DE programs are offered at high schools; 43 states offer DE courses at college campuses, and 35 states provide online access to DE courses (ECS, 2019). According to the U.S. Department of Education (2019), 86% of dually enrolled students have taken at least one DE course at a high school, 17% at a college campus, and 8% online. Understanding the impact of different DE delivery locations is critical because it may influence student success differently. For one, DE programs offered at high schools help students understand the academic expectations for a college student (Karp, 2012). Moreover, taking DE courses in a high school provides easier access for students by addressing the logistical challenges, such as class scheduling and transportation (Zinth, 2015). Studies have revealed more similarity than differences in the rigor of DE courses taught by high school teachers and college faculty by analyzing instructor perceptions and course components (Ferguson et al., 2015; Miller et al., 2018). However, high school DE instructors use different instructional strategies, require students to master different skills, and face additional challenges than college instructors (McWain, 2018; Miller et al., 2018). These pedagogical differences can influence students' college readiness and postsecondary performance (Bausmith & Barry, 2011; Schwartz et al., 2009; Tai & Sadler, 2007).

For the other, whether students are both academically and socially mature for college upon DE course-taking has been a major concern (Ferguson et al., 2015; Garcia et al., 2019;

Karp, 2012; Miller et al., 2017). The academic preparation and social engagement brought by DE programs in a college setting can support students to transition to postsecondary education more easily and eventually earn a credential (Bailey et al., 2002; Berger et al., 2014). DE programs on college campuses can further provide exposure to college-level course expectations, high-achieving peers, and college campus culture, especially for economically and racially minoritized students (Bailey & Karp, 2003; Karp et al., 2007; Kim & Bragg, 2008). Given how colleges and universities have also provided financial aid and support services to address the logistic challenges for high school students (Jordan, 2001; Lukes, 2014; Roach et al., 2015), enrolling in DE courses on a college campus may better support dually enrolled high school students both academically and socially.

The Impact of Dual Enrollment on Student Success

Previous studies have indicated that dual enrollment has a positive impact on student outcomes. Specifically, dually enrolled students are more likely to be college ready, which is measured by high school graduation, developmental course-taking, and postsecondary attendance (An, 2013b; An & Taylor, 2015; Cowan & Goldhaber, 2015; Kim & Bragg, 2008; Rodríguez et al., 2012; Struhl & Vargas, 2012). The impact of DE can persist over the college years and positively influence students' first-year GPA, retention, degree attainment, and time-to-degree (Allen & Dadgar, 2012; An, 2013a, 2015; Bailey & Karp, 2003; Giani et al., 2014; Grubb et al., 2017; Hunter & Wilson, 2019; Miller et al., 2017; Phelps & Chan, 2016; Radunzel et al., 2014; Taylor, 2015; Taylor & Yan, 2018; Wang et al., 2015).

In particular, a handful of studies examined the relationship between DE delivery location and student outcomes. For example, Smith (2007) suggested that DE students taking classes on a college campus have higher educational aspirations than their peers taking DE classes in a high school. Consistently, a qualitative study conducted by Burns and Lewis (2000) found that dually enrolled students viewed DE courses on a college campus to be of "greater value" (p. 7). D'Amico and colleagues (2013) found that students who were dually enrolled in classes on a South Carolina technical college were more likely to persist to the second year than students who dually enrolled in a high school. Using data from two cohorts of all public high school students in Florida, Speroni (2011) found a positive effect of DE on students' likelihood of college enrollment and bachelor's degree attainment. However, this significant effect was driven by students who took DE courses at the local community college campus, but not for students who took DE courses in a high school. On the contrary, Phelps and Chan (2016) used institutional data from a Wisconsin technical college and found that DE courses offered at high school and taught by certified high school teachers are related to greater levels of college student success (i.e., college course completion, second-year retention, three-year graduation) and better labor market outcomes, but such positive linkage was not found with DE courses offered at the technical college.

The Role of DE Programs in Postsecondary Access and Equity

Upon years of program expansion efforts, DE courses are relatively more accessible for high school students even without stellar academic performance than that of Advanced Placement (AP) and International Baccalaureate (IB) courses (Barnett, 2018; Xu et al., 2021). However, prior studies have repeatedly noted that students' access to DE programs remains to be limited for economically and racially minoritized students, largely due to the DE eligibility criteria (e.g., GPA, standardized test scores, and written recommendations from high school teacher or counselor) in most states (ECS, 2019; Zinth & Barnett, 2018). For example, Museus et al. (2007) noted that White and affluent students in Pennsylvania high schools are more likely to take DE courses, and this finding closely aligns with studies carried out in other states despite varying statewide policies (Pierson et al., 2017; Xu et al., 2021). Even after the state of Virginia's attempt of expanding DE participation, students of color remained to be underrepresented in DE course-taking (Pretlow & Wathington, 2014). State-specific analyses in Kentucky have shown that dually enrolled students that are economically and racially minoritized are also less likely to complete and earn DE credits (Lochmiller et al., 2016). Xu and colleagues' (2021) recent national analysis also indicated that greater district-level resources devoted to DE access can actually engender racial disparity in DE enrollment, if equity efforts are inadequate.

The academic benefits associated with taking DE courses appear to be stratified on students' sociodemographic characteristics. While some studies found that economically and racially minoritized students may benefit more from DE's positive effects in terms of postsecondary access, persistence, and degree attainment(An, 2013a; Karp et al., 2007; Henneberger et al., 2020), this disparate effect was not found for their first-year GPA (An, 2013b). On the contrary, Taylor (2015) used Illinois' administrative data and found smaller effect sizes for economically and racially minoritized students when examining the relationship between DE participation and college success. To prevent DE programs from exacerbating achievement gaps among students that are economically and racially minoritized, intentionally designed programs and policies should be in place (Moore, 2019; Pompelia, 2020).

A Theoretical Perspective on College Exposure and Beyond

As taking DE on a college campus signifies an exposure to college campus, learning environment, and instructional style, it is very likely that students will have a unique learning experience that taking courses in high school cannot replace. The bioecological theory

(Bronfenbrenner, 1999; Rosa & Tudge, 2013) posits that the continuity of learning and development, as well as the environment in which such continuity takes place, is at the core of human growth. In the proximal process, individuals proactively engage in increasingly complex and reciprocal interpersonal exchange with close social and institutional agents (e.g., teachers). As such, the nature and quality of the interaction over time shape and reshape individuals' learning experience and outcomes. Furthermore, the proximal process is nested in the immediate learning environment (e.g., school), indicating that different learning environments (e.g., online, in a high school, in a college) indirectly cast varying influence, called the *distal process* in bioecological theory, on the learning process and experience. Meanwhile, empirical research should adopt a proper design to capture the continuity and change within and across different learning environments (Bronfenbrenner & Morris, 2007). Given the variety of DE program settings, the indirect, contextual factors in DE programs must be systematically addressed.

Focusing on the continuity of the academic pursuit, the social cognitive career theory (SCCT) further delineates the trajectories through which individuals realize the chosen career goals (Lent et al., 2000). Particularly for racially and economically minoritized students, their self-efficacy, outcome expectations, and personal goals may be influenced by the larger social and economic contexts (Fouad & Santana, 2017). First of all, one's realization of educational and career goals starts with the accumulation of learning experiences by helping individuals chart an attainable career goal along with necessary knowledge, skills, and action plans to achieve the goal. Prior learning experience, in turn, informs the formation of further educational and career intent, as well as fuels motivational attributes (e.g., self-efficacy beliefs). Afterward, individuals carry out the action plan and work towards reaching the academic and career goal step by step, actualizing the goal eventually (e.g., college graduation; Lent & Brown, 2013). Joining the bioecological theory, SCCT argues that learners' background characteristics and the learning environment may stimulate or hinder individuals' learning trajectory, calibrating the paths individuals undertake during the process (Lent et al., 2000). In addition, SCCT points out the importance of self-efficacy beliefs and outcome expectations that critical motivational factors may change the way individuals carry out the original plan (Lent et al., 2008).

Taken together, the bioecological theory depicts the multiple contextual processes that calibrate learners' growth, whereas SCCT dissects the processes in which learners reach the academic and career goals through the accumulation of learning experiences. In the present study, a combination of both theories calls for an equal attention to the attainment of learning experiences and the context in which such attainment takes place. While it remains unclear whether the delivery location of DE leads to differences in postsecondary outcomes, high school and college instructors tend to have fundamentally different instructional strategies (Conley, 2007). In turn, students taking DE in different environments (e.g., online, on college campus, or on high school campus) will gain unique learning experiences. Based on their prior exposure to the college environment and DE instruction, students in transition may approach college with varying levels of aspiration, preparation, and motivation for postsecondary education (Lent et al., 2003).

Current Study

While we gain more knowledge of the influence of DE on students' academic outcomes, the limited studies on the delivery location of DE courses provided correlational findings at best: Existing research did not control for the selection bias of students choosing DE in a high school or at a college, which, according to the bioecological theory (Bronfenbrenner, 1999), in turn influences students' subsequent learning experience and outcomes. Students' choice of a certain

DE delivery location can be influenced by their academic motivation (Ozmun, 2013), whether a student lives in a rural area (U.S. Department of Education, 2019, 2020), and other individual preferences. Following the bioecological theory and SCCT, since motivational and contextual factors further contribute to students' academic performance (Byun et al., 2012; Horyna & Bonds-Raacke, 2012), the influence of DE on college readiness and academic momentum is confounded by delivery location, and it should therefore be systematically addressed.

Additionally, we argue that to further elucidate the influence of DE on postsecondary outcomes, attention should be paid to viable ways DE cultivates academic momentum. According to Adelman (1999, 2006), a student's academic momentum refers to the culmination of years of preparation and effort toward academic outcomes early in college, including immediate college attendance after high school, number of credits earned in the first year, first-year GPA, course-taking patterns, and persistence. They are incremental steps students have to accomplish at the initial phase of college that are conducive to academic achievement (Adelman, 1999; Attewell et al., 2012). Resonating with the bioecological theory and SCCT, students' sociodemographic characteristics, academic knowledge and skills, motivational attributes and beliefs, and exposure to college norms have been found to contribute to their academic momentum (Barnett, 2016; Martin et al., 2013; Wang, 2017). In essence, a strong start has been found to be particularly predictive of the possibility of realizing individuals' long-term academic and career plan. Subsequently, students with a high level of momentum tend to be more likely to achieve academic success on time.

Finally, following the emphasis of bioecological theory and SCCT on the contextual attributes of individuals' development, we advocate more systematic research on how DE sustains equitable access to and cultivation of early academic momentum for economically and racially minoritized students. The glaring disparity between school districts to afford multiple DE programs, between family to provide necessary support (e.g., transportation), and between students of varying sociodemographic background to utilize DE opportunities (An & Taylor, 2019) should be properly addressed. Given that existing studies have repeatedly confirmed the importance of academic momentum on students' success in later years (Attewell et al., 2012; Chan & Wang, 2018; Doyle, 2011; Martin et al., 2013; Wang, 2017), it is time to understand whether the impact of the delivery location of DE on academic momentum varies by students' sociodemographic background. Accordingly, we employed propensity score models, which are advocated by An and Taylor (2019) and already widely used in policy-related quantitative studies (e.g., Crisp, 2013; Wang, 2015), and accounted for pre-existing physical conditions (e.g., resources in the school district), motivational attributes (e.g., self-efficacy belief), and sociodemographic background (e.g., race/ethnicity) that may influence students' access to and use of DE opportunities.

As such, following the framework of the bioecological theory and SCCT, in the current study, we attempted to explore the influence of DE, varying in the location of delivery, on students' college readiness and accumulation of academic momentum with a special focus on its heterogeneous effect among students of diverse background.

Methods

Data and Sample

We analyzed the restricted-use data from High School Longitudinal Study of 2009 (HSLS:09) to answer our research questions. Conducted by the U.S. Department of Education, HSLS is a nationally-representative, large-scale panel dataset. HSLS:09 firstly surveyed over 23,500 9th graders in 2009 (termed BY hereafter), and followed up in 11th grade (2012; termed

F1 hereafter), right after high school graduation (2013; termed U13 hereafter), and three years after high school graduation (2016; termed F2 hereafter). In the present study, students' survey responses from BY, F1, and F2, as well as high school transcript record included in U13 were matched and analyzed.

Given the overall effect of DE has been extensively studied (e.g., Allen & Dadgar, 2012; An, 2013a, 2013b, 2015; An & Taylor, 2015; Cowan & Goldhaber, 2015; Grubb et al., 2017; Phelps & Chan, 2016; Taylor, 2015), we focused on unpacking the influence of DE course-taking on a college campus versus DE course-taking at other locations. To address our research questions, we restricted our sample to 3,920 students (unweighted) who have taken at least one DE course by 11th grade, with 640 of them took at least one DE course on a college campus and 3,280 never on a college campus.[1]

In order to examine the heterogeneous effects of DE location on student performance due to structural inequity, we created four subgroups based on student's race and socioeconomic status (SES). In particular, we used the median split approach to form lower (below the median) and higher (above the median) SES groups (Iacobucci et al., 2015; Mathur et al., 2013). The full sample includes 1,700 (43.3%) students of color and 2,220 (56.7%) White students, as well as 1,950 (49.8%) lower SES students and 1,970 (50.2%) higher SES students. For models with outcomes related to college attendance, we further limited our sample to those who have ever attended a postsecondary institution by 2016 (*n* = 2,670). Among them, 1,330 (49.9%) students are in the lower SES group, 1,340 (50.1%) in the higher SES group, along with 1,120 (41.9%) as students of color and 1,550 (58.1%) as White. To complement our research questions on the equitable influence of DE by locations, in the subsample analyses, the SES and racial/ethnic characteristic as grouping variables serve as moderators to demonstrate the intersection of SES or race/ethnicity with other predictors identified in the regression models.

Variables

Based on previous literature (e.g., Adelman, 1999; An, 2013b; Wang, 2017; Wang et al., 2015), we included five dependent variables that measure a student's college readiness and first-year academic momentum, including high school GPA for academic courses (derived from students' high school transcript record reported in U13), college attendance by 2016 (derived from students' survey in F2), developmental education (derived from students' survey in F2), delayed enrollment (derived from students' survey in F2), and full-time enrollment status (derived from students' survey in F2). The treatment variable is the location of early DE course(s) taken as of 11th grade from student survey completed in F1, which was dummy coded as 0 if taking no DE course on a college campus by 2012, 1 if they have taken at least one DE course on a college campus as of 11th grade.

Pre-treatment covariates included students' demographics (e.g., gender, race/ethnicity, SES), motivational attributes (e.g., self-efficacy belief in math and science[2], postsecondary aspiration, education plan, academic advising participation), and GPA, all measured at 9th grade. In line with our literature review, the highest level math course taken by the 12th grade and the number of earned AP and IB credits were included in the analytical models as additional post-treatment controls, as these indicators were found to impact students' college access and first-year academic momentum (Kim et al., 2015; Wyatt et al., 2015). Table 1 presents all variables used in the current study with detailed characteristics.

---Table 1 Here---

Analytical Procedures

First of all, we addressed the missing values before estimating any analytical models. Specifically, the percentages of missing cases are highest for math self-efficacy belief (16.5%) and science self-efficacy belief (22.6%), and the percentages of missing cases for other variables were lower than 10%. To handle missing values of predictor variables, we used multiple imputation with sampling weight to generate five imputed datasets in Stata. Cases with missing values for the outcome variables were deleted due to the small percentage of missing values. [3]

Second, choosing whether to take DE courses on a college campus can be subject to factors such as students' pre-existing differences as opposed to the treatment (e.g., individual preferences, distance to a college campus). To reduce selection bias between the treated group and control group, we utilized inverse probability weighting (IPW) models to ensure overlap and comparability between the treated groups and the control group (Guo & Fraser, 2015; Morgan & Winship, 2007). In this study, the average treatment effect on the treated (ATT) reveals what the outcomes would have been for college campus DE enrollees had they not taken an early DE course on a college campus.

Following Caliendo and Kopeinig's (2008) variable selection strategy, we included a set of pre-treatment covariates to predict the likelihood of taking DE course(s) by their 11^{th} grade on a college campus for individual students. Specifically, we used logistic regression to estimate the propensity score p for each observation based on treatment probabilities to reduce the selection bias between treated and control students. To ensure our findings are representative of the population, we followed Ridgeway et al. (2015) to include sampling weights, primary sampling unit, and strata in the IPW specifications. The resulted propensity score was used to calculate ATT weights for each observation, which equals to 1 for the treated observations, and $p/(1 - p)$ for the control observations. The same procedure was repeated to estimate a set of ATT weights for the full sample, college-attending sample, and SES and racial/ethnic group subsamples respectively, following the suggestions of previous work (Guo & Fraser, 2015; Hu & Ortagus, 2019).

Table 2 presents the mean difference in pre-treatment covariates between pre- and post-weighting for the full sample and college-attending sample. Figure 1 presents the density of estimated propensity scores for the full sample and college-attending sample pre- and post-weighting, respectively. Given the results of the balance test, we were able to provide evidence of meeting the common support assumption to use IPW, and the weighting procedure created a comparable control group to the treated group. In other words, students in the treated group and the control group have a statistically equivalent likelihood to take DE course(s) on a college campus as of their 11th grade.

---Table 2 & Figure 1 Here---

To estimate the influence of location of early DE course-taking on the outcomes, we used a series of linear and logistic regression models that control for the pre- and post-treatment variables:

$$\gamma_i = \alpha_{1i} + \beta_1 Treat_i + \beta_2 Z_1 + \beta_3 Z_2 + \varepsilon_{1i}$$

Where $Treat_i$ indicates whether a student took DE course(s) on a college campus as of their 11th grade, and β_1 is the parameter estimate associated with our treatment effect. Z_1 represents vectors of pre-treated covariates that include a student's demographics, academic performance, and motivational measures. Z_2 represents vectors of post-treatment covariates, and ε_i is the idiosyncratic error term. Pre-treatment factors were included in both the IPW model and outcome model as a doubly robust approach, and post-treatment factors were only included in the outcome model. Finally, to address the differences in DE availability at each high school and contextual characteristics that are central to the bioecological theory, high school fixed effects were controlled for in all models by specifying the primary sampling unit and strata. The weight was a product term between the ATT weight and the longitudinal sampling weight, divided by the mean of such product term to ensure generalization of results (Leite, 2016).

Limitations

It is worth noting that our findings should be interpreted with cautions, especially when large standard errors are present which indicate substantial variations between the academic outcomes and their predictors. For one, the high school transcript record included in HSLS did not document students' DE location record; rather, 11^{th} grade students' self-report of DE participation was the only source of information about students' DE location. It is likely that DE offered by different postsecondary institutions, such as two- and four-year colleges, may differ in the expectations, quality of instructions, and accessibility to students, yet HSLS dataset did not inquire the type of postsecondary institution where the participants took DE (Taylor & Yan, 2018). Since DE programs are highly localized, future research can use datasets with district- and college-level curriculum information (Wang et al., 2015), coupled by a cross-examination of college transcript record, to provide updated local implications.

For the other, while we strived to account for the self-selection mechanism of DE participation, it is likely that other unobserved variables, such as whether students were motivated to participate in DE courses to recover high school credits, may play a role in their decision to dually enroll on a college campus or not. It is thus necessary in future research to collect pre-high school factors that may contribute to students' and parents' educational decision. Similarly, the quality of DE program, whether it was delivered on a four-year university or two-year community college campus may vary in terms of inspiring students for postsecondary education or preparing students for a stronger early academic momentum after entering college. As such, our quasi-experimental approach yielded a weak causal evidence of the influence of DE on college readiness and early academic momentum in college. Future studies can further account for the number and subject area of DE credits earned to disaggregate the influence of DE on student success.

Results

Descriptive Statistics

Table 3 presents the descriptive summary of outcomes for the treated and control groups. Before incorporating the ATT weights, the college DE group seems to include students with higher average high school GPA (3.319), higher percentage of college attendance (82.91%) and full-time enrollment (86.95%) than the no-college-DE group. Only 12.86% of college-DE students took developmental courses, compared with 20.7% of students who did not take DE courses on a college campus. The treated students also have a lower percentage of delayed enrollment of 6.91%, as opposed to 9.09% of the control group. However, after incorporating the ATT weights, the descriptive differences of outcomes between the two groups are reduced (see a summary of all variables in online Appendix available at: https://commons.lib.niu.edu/handle/10843/22891).

As presented in Table 4, students of various sociodemographic background in the treated and control group do not drastically differ in high school GPA and college attendance, after accounting for the pre-treatment covariates. However, the subgroups of college attendees seem to vary in the probability of taking developmental courses, delaying college attendance, and enrolling full-time. For example, among college students with lower SES, those in the treated group were nearly twice as likely as the control group to delay their college enrollment.

---Table 3 and 4 Here---

The Influence of Taking Early DE on College Campus

Due to space limitation, we only focused on the results of doubly robust model specifications (see Panel B in Table 5). Compared with 11th grade students who did not take any DE on a college campus, those who took at least one DE course on a college campus had no significant differences in college readiness and first-year academic momentum. In other words, taking an early DE course on a college campus does not significantly influence a student's high school GPA, probability of attending a postsecondary institution, taking a developmental course, delaying enrollment at a college, or enrolling full-time, accounting for students' demographics, academic, and motivational characteristics. However, students' other measures of SES and academic performance in high school are better predictors for their college readiness and first-year academic momentum. For example, students' SES, 9th grade GPA, and the number of AP/IB credits earned are positively associated with college readiness and the accumulation of academic momentum (see online Appendix B). Other sociodemographic discrepancies in the five outcomes of college readiness and first-year academic momentum were not consistently observed.

---Table 5 & Table 6 Here---

The findings also indicated heterogeneous effects of taking early DE courses on a college campus across SES groups, but not for racial/ethnic groups (see Table 6). In particular, for 11th graders with higher SES, taking at least one early DE course(s) on a college campus is associated with a 0.058 unit increase in high school GPA for academic courses (β = 0.058, p = .025) and 62.7% lower likelihood of taking a developmental course (β = -0.986, p = .004). On the contrary, lower-SES students who took at least one early DE courses on a college campus have a

37.5% lower likelihood of enrolling full-time, when compared with lower-SES students who took DE courses elsewhere (β = -0.470, p = .005). Within the lower and higher SES subgroups (see online Appendix C-1 and C-2, respectively), we observed certain statistically significant racial/ethnic differences between students of color and White students in the probability of college attendance and first-year academic momentum indicators, but such relationships in the lower and higher SES groups vary. That is, DE students' SES and racial/ethnic background intersects to a certain degree.

We did not observe notable differences of college readiness and first-year academic momentum between the treated and control groups within particular racial/ethnic groups. Among students of color who took at least one DE course as of their 11th grade, students' SES is positively related to their high school GPA, but not other outcomes (see online Appendix C-3). Within White subgroups, however, SES remains a statistically significant predictor of all college readiness and first-year academic momentum, except for delayed enrollment, holding DE locations and other control variables constant (see online Appendix C-4).

Discussion and Implications

Building upon previous work on the impact of delivery location of DE (D'Amico et al., 2013; Phelps & Chan, 2016; Smith, 2007), this study uses a nationally representative dataset and quasi-experimental approaches to reduce self-selection bias of choosing DE delivery location. In general, we did not find DE students who took at least one DE on a college campus by their 11th grade more likely to be college ready or accumulate first-year academic momentum than those who did not. Within subgroups defined by race/ethnicity, the delivery location of early DE course(s) largely does not contribute to students' college readiness and the accumulation of academic momentum. In contrast, students with higher SES background who took at least one

DE course on a college campus are more likely to have higher high school GPA and less likely to take developmental classes once enrolled in college. College students with lower SES background who took at least one DE course on a college campus are less likely to enrolled full-time, when compared with their peers who took DE course(s) elsewhere. The findings further provide implications for equitable DE practices.

First and foremost, it appears that DE course taken on a high school or college campus equally fuel students' college readiness and early academic momentum. Though taking DE courses on a college campus may be of greater value perceived by students (Burns & Lewis, 2000; Smith, 2007), its statistically positive impact on measurable outcomes was not observed. Using the bioecological theory (Bronfenbrenner, 1999), it seems that the varying distal processes are actually similar in their effect on individuals' learning. According to the National Alliance of Concurrent Enrollment Partnerships (NACEP) accreditation standards and the statewide DE policy requirements, DE courses are often designed with consistent quality and delivered under supervision of college faculty, regardless of its delivery location (Scheffel et al., 2015; Taylor & Yan, 2018). While students take DE courses on a college campus can benefit from an intensive exposure to a postsecondary environment, students taking these courses on high school campus may be surrounded by instructors who have already built a nurturing relationship with the students and been equipped with background knowledge of the students. In turn, the positive teacher-pupil relationship may strengthen their learning outcomes, self-efficacy beliefs, and preparation for college (Lent et al., 2000; Ozmun, 2013). Students enrolled in DE offered by colleges may end up sitting in a large class without the close attention from the instructor (Klopfenstein & Lively, 2012).

Validating the collaboration between high schools and postsecondary institutions to build DE programs together, our findings suggest that advising practices should acknowledge the benefits of DE courses regardless of delivery location. Resources should continue to be allocated to DE programs in different settings to provide all students access to college-level courses. Especially for school districts that are not adjacent to a college, their capacity to offer DE programs can critically support students' postsecondary success (Klopfenstein & Lively, 2012). As such, more research is needed to further uncover the geographical dependence of the access to various types of DE programs and their influence on student outcomes.

Another major finding is that DE students with different SES backgrounds can benefit from the program in terms of college readiness and first-year academic momentum indicators simply due to DE delivery location. While lower SES students are not hindered by overall DE participation (An, 2013a, 2013b), DE participation with college exposure may in particular benefit higher SES students, who tend to be continuous-generation college students and from more affluent families. One possible explanation is that lower SES students perceive and/or experience more barriers on college campuses, and they do not benefit as much from interactions with faculty when compared with their higher SES peers (Padgett et al., 2012; Pike & Kuh, 2005; Stephens et al., 2012). In other words, it is plausible that, as delineated in the bioecological theory (Rosa & Tudge, 2013), the proximal processes remain a more critical source of influences on individuals' learning outcomes and academic prospect than distal processes.

Our study provides evidence that the varying treatment effect of taking early DE on a college campus is primarily driven by students' SES, rather than one's race/ethnicity, yet the two background characteristics may intersect. This finding also aligns with previous work that students' social class and available resources can determine their education opportunities and outcomes (McDonough, 1997; St. John, 2004). The results emphasize the demand of interventions which offers holistic college experiences beyond academic work to effectively prepare lower SES student for college life and accumulate academic momentum (Schademan & Thompson, 2016). Indeed, college preparation and student success intervention programs often have a series of academic, financial, and mentoring elements to be effective (Carruthers & Fox, 2016; Castleman & Page, 2015). As Garcia et al. (2019) noted, DE courses may improve students' college-level academic works, but it may not socially engage students in an inclusive college environment, especially for the economically and racially minoritized students. Other precollege programs can include campus visits to offer students taking DE courses in a high school with clear expectations about college, providing a smooth transition for them to academically and socially engage on a college campus (Secore, 2018; Singer, 2003). Future research can employ a critical perspective to understand the intersection of students' social identities, challenge the current DE mechanism, and reshape DE programs to empower participating students that are racially and economically minoritized.

Finally, our findings support policymakers to understand the influence of different DE models to address the structural inequity in higher education. For example, for students in rural areas or students with no reliable access to a college campus, taking DE courses in a high school or online serves as a viable option without being penalized by the limited resources. In at least eight states, students may also take developmental courses through DE programs to be more academically prepared for college-level work (ECS, 2019). National organizations, such as the College in High School Alliance (CHSA), have been advocating for multiple measures to assess student readiness to ensure equal DE participate (CHSA, 2020). Based on our findings, states and educational entities should be mindful about the potential disparate effect of DE delivery location on SES subgroups, ensuring their regulation, oversight, and quality assurance in DE programs can narrow the postsecondary achievement gap.

[1] In accordance with Institute of Education Sciences (IES) reporting standards for restricted-use data, all sample sizes are rounded to the nearest ten.

[2] The two variables *math self-efficacy belief* and *science self-efficacy belief* were created by the U.S. Department of Education through principal components factor analysis based on their respective relevant survey item responses. These survey items include how confident 9th grade students are that they can do an excellent job on tests and assignments in this Math/Science course, and how certain 9th grade students are that they can understand the Math/Science textbook(s) and master skills in the Math/Science course(s).

[3] Specifically, 3.93% of the analytical sample do not have a valid value for high school GPA. Among the 2,670 college attendees, 7.91%, 0.75% and 0.34% have missing values for developmental course-taking, delayed enrollment, and full-time enrollment, respectively.

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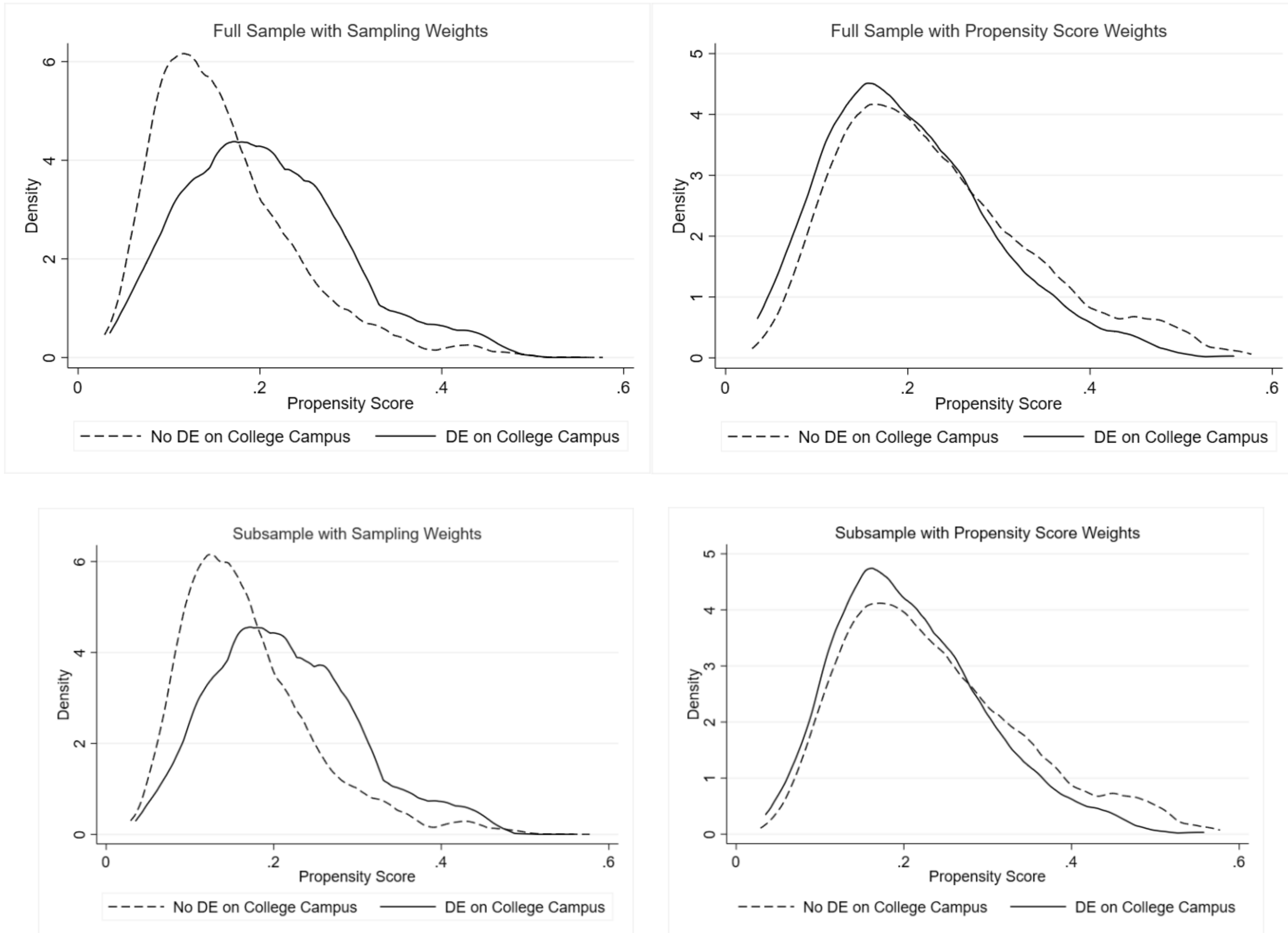
Figure 1. Estimated Propensity Scores for Full Sample and College-Attending Subsample



SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016

Table 1. Characteristics of variables in outcome model

	Variable	Variable Characteristic	HSLS Variable Name
Outcome Variable	High school GPA for academic courses	Continuous (weighted)	X3TAGPAWGT
	College attendance	0 = No college attendance by 2016; 1 = Ever attended any postsecondary institution by 2016	X4ATNDAPPINST
	Taking developmental courses	0 = No developmental course since high school+; 1 = Took any developmental course(s) since high school	S4REMEDIAL
	Delayed enrollment	0 = No delayed enrollment+; 1 = Delayed enrollment	X4FB16ENRSTAT
	Full-time Enrollment	0 = Mostly part-time or mixed+; 1= Mostly full-time	S4CLGFTPT
Treatment Variable	Dual-credit enrollment on a college campus as of 11th grade	0 = take no dual-credit course(s) on a college campus+; 1 = take at least one dual-credit course(s) on a college campus	S2DUALCLG S2DUALHS S2DUALOTHHS S2DUALONLINE
Pre-treatment Covariates	Race	1 = White+; 2 = African American/Black; 3 = Latinx; 4 = Asian; 5 = Native American; 6 = Multiracial	X1RACE
	Sex	0 = Male+; 1 = Female	X1SEX
	Socioeconomic Status (SES)	Continuous	X1SES
	High school GPA for academic courses in 2009	Continuous	X3TAGPA09
	Educational aspiration in 2009	0 = Do not know; 1 = High school or below; 2 = Start and/or complete associate degree; 3 = Start and/or complete bachelor's degree; 4 = Start and/or complete master's degree; 5 = start and/or complete doctoral or professional degree+	S1STUEDEXPECT

	Education plan in place	0 = No educational plan in place+; 1 = Educational plan in place	S1PLAN
	9th grader talked to school counselor about courses	0 = No; 1 = Yes	S1CNSLTALKM, S1CNSLTALKS, S1CNSLTLKOTH
	Math self-efficacy belief	Continuous	X1MTHEFF
	Science self-efficacy belief	Continuous	X1SCIEFF
Post-treatment Covariates	Highest level math course taken in 12th grade	0 = missing; 1 = Algebra 1 or below; 2 = Geometry; 3 = Algebra 2; 4 = Advanced Algebra/Trigonometry/other level 3 course; 5 = Calculus or Precalculus	X3THIMATH
	Number of earned AP/IB credits	Continuous	X3TCREDAPIB

NOTE: + Reference category in the following regression analyses.
SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016.

Table 2
Standardized differences of the unweighted and weighted sample

Variable	All DE Students		College-Attending DE Students	
	Sampling weights	IPW	Sampling weights	IPW
Race/Ethnicity				
African American/Black	-0.010	-0.085	0.006	0.004
Hispanic/Latinx	0.061	-0.078	0.041	-0.111
Asian/Pacific Islander	0.064	-0.046	0.045	-0.021
Other	0.065	0.036	0.072	-0.035
Female	0.107	-0.189	0.112	-0.156
SES	0.164	-0.059	0.145	-0.030
High school GPA for academic courses in 2009	0.246	-0.087	0.241	-0.068
Educational aspiration in 2009				
High School or Below	-0.184	-0.067	-0.167	0.012
Start and/or complete associate degree	-0.061	0.078	-0.093	0.010
Start and/or complete bachelor's degree	-0.073	0.127	-0.059	0.124
Start and/or complete master’s degree	0.029	0.100	0.055	0.131
Start and/or complete doctoral/professional degree	0.220	-0.186	0.196	-0.194
Education plan in place	0.147	-0.086	0.197	-0.082
9th grader talked to school counselor about courses	0.078	-0.020	0.048	0.032
Math self-efficacy belief	0.184	-0.167	0.218	-0.129
Science self-efficacy belief	0.185	0.040	0.167	0.020

NOTE: DE = dual enrollment. IPW = inverse probability weighting
SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016.

Table 3

Descriptive statistics of the Dependent Variables

Variable	Sampling weights		IPW	
	No DE on college	At least one DE on college	No DE on college	At least one DE on college
High School GPA [a]	3.048 (0.030)	3.319 (0.030)	3.436 (0.022)	3.408 (0.021)
College Attendance [a]	81.88%	82.91%	90.18%	89.11%
Taking Developmental Courses [b]	20.70%	12.86%	14.58%	13.41%
Delayed enrollment [b]	9.09%	6.91%	7.07%	7.82%
Full-time enrollment [b]	85.04%	86.95%	90.39%	87.81%

NOTE: The statistical significance of the estimated coefficients are based on robust standard errors. DE = dual enrollment. IPW = inverse probability weighting

[a] Based on students who have taken dual enrollment courses

[b] Based on students who have taken dual enrollment courses and attended a postsecondary institution

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016.

Table 4

Descriptive statistics of the Dependent Variables for Subgroups (IPW)

Variable	Lower SES		Higher SES		Students of Color		White	
	No DE on college	At least one DE on college	No DE on college	At least one DE on college	No DE on college	At least one DE on college	No DE on college	At least one DE on college
High School GPA [a]	3.008	2.977	3.690	3.580	3.291	3.239	3.521	3.422
College Attendance [a]	81.93%	82.57%	93.83%	93.47%	89.04%	88.96%	91.86%	89.23%
Taking Developmental Courses [b]	20.18%	23.77%	9.65%	6.09%	18.39%	17.20%	10.62%	10.52%
Delayed enrollment [b]	10.95%	6.91%	4.19%	8.50%	9.35%	7.28%	5.52%	8.25%
Full-time enrollment [b]	85.70%	80.67%	93.55%	93.18%	87.92%	85.40%	92.76%	89.67%

NOTE: DE = dual enrollment. IPW = inverse probability weighting

[a] Based on students who have taken dual enrollment courses

[b] Based on students who have taken dual enrollment courses and attended a postsecondary institution

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016.

Table 5

Multiple regression and logistic regression analyses (Full sample)

	High School GPA[a]	College Attendance[a]	Taking Developmental Courses[b]	Delayed Enrollment[b]	Full-time Enrollment[b]
Panel A: The impact of location of DE (sampling weights)					
DE on college campus	0.041	0.037	-0.503	-0.136	-0.084
	(0.033)	(0.328)	(0.268)	(0.244)	(0.225)
# of observations	3,720	3,800	2,430	2,580	2,590
Panel B: The impact of location of DE (IPW)					
DE on college campus	0.024	0.130	-0.185	-0.007	-0.222
	(0.021)	(0.194)	(0.172)	(0.206)	(0.171)
# of observations	3,410	3,490	2,270	2,420	2,430

NOTE: The statistical significance of the estimated coefficients are based on robust standard errors. Please refer to Table 1 for a complete description of the variables. All models were estimated with the robust maximum likelihood estimator (MLR) and weighted by the product of sampling weight and propensity score weight, divided by the mean of the product term; DE = dual enrollment. IPW = inverse probability weighting

[a] Based on students who have taken dual enrollment courses

[b] Based on students who have taken dual enrollment courses and attended a postsecondary institution

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016.

Table 6

Multiple regression and logistic regression analyses (Subgroup sample)

	High School GPA[a]	College Attendance[a]	Taking Developmental Courses[b]	Delayed Enrollment[b]	Full-time Enrollment[b]
Panel A: The impact of location of DE (sampling weights)					
Lower SES	-0.005	0.050	-0.080	-0.589	-0.108
	(0.043)	(0.401)	(0.327)	(0.335)	(0.218)
Higher SES	0.101**	0.529	-1.760**	0.797**	0.118
	(0.038)	(0.374)	(0.600)	(0.299)	(0.354)
Students of Color	0.065	0.148	-0.492	-0.591	0.063
	(0.054)	(0.448)	(0.340)	(0.431)	(0.346)
White	0.016	-0.189	-0.376	0.16	-0.240
	(0.030)	(0.271)	(0.339)	(0.244)	(0.218)
Panel B: The impact of location of DE (IPS)					
Lower SES	-0.021	0.258	0.290	-0.452	-0.470**
	(0.028)	(0.250)	(0.196)	(0.280)	(0.166)
Higher SES	0.058*	0.181	-0.986**	0.422	0.252
	(0.026)	(0.237)	(0.337)	(0.278)	(0.264)
Students of Color	0.056	0.152	-0.185	-0.181	-0.259
	(0.031)	(0.287)	(0.208)	(0.297)	(0.215)
White	-0.011	0.023	-0.180	0.179	-0.256
	(0.026)	(0.215)	(0.246)	(0.264)	(0.210)

NOTE: The statistical significance of the estimated coefficients are based on robust standard errors. Please refer to Table 1 for a complete description of the variables. All models were estimated with the robust maximum likelihood estimator (MLR) and weighted by the product of sampling weight and propensity score weight, divided by the mean of the product term; DE = dual enrollment. IPW = inverse probability weighting

[*] $p < .05$, ** $p < .01$.

[a] Based on students who have taken dual enrollment courses

[b] Based on students who have taken dual enrollment courses and attended a postsecondary institution

SOURCE: U.S. Department of Education, National Center for Education Statistics, High School Longitudinal Study of 2009. Selected years 2009, 2012, 2013, and 2016.