Dual-Credit Education Programs in Texas

Phase II

OCTOBER 2018

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Preface

Dual-credit education has become a popular vehicle in Texas and other states to encourage more students to enroll in college and to complete college degrees or credentials. Delivered through partnerships between high schools and postsecondary institutions, dual-credit education offers high school students the opportunity to enroll in college-level courses that concurrently award them college and high school credit.

In the last two decades, dual-credit education programs across Texas have expanded and evolved to support a broad array of high school students who represent varying degrees of academic preparation for college-level coursework; varying levels of prior exposure to college; and diverse college aspirations. As a result, dual-credit stakeholders have focused their attention on the quality, efficacy, and cost-effectiveness of dual-credit education programs as they scale programs across the state.

This report presents findings from the second and final phase of an in-depth, two-part study designed to inform discussions around dual-credit education in Texas and to guide policy-making and practice. Results of the study's first phase (Phase I), conducted by RAND and published in an interim report in August 2017, provided an initial perspective on the accessibility, diversity, quality, and efficiency of dual-credit education in Texas (Miller et al., 2017).

Phase II of the study—the focus of this report—builds on the research activities and findings of Phase I and is comprised of six separate study components: (1) the direct effect of dual-credit education on student outcomes prior to the passage of House Bill (HB) 505; (2) dual-credit advising practices and procedures; (3) factors that contribute to racial and ethnic disparities in dual-credit education participation; (4) the academic rigor of dual-credit courses relative to college credit-only courses; (5) the costs and benefits of delivering dual-credit education; and (6) changes in patterns of student participation in dual-credit education, the outcomes of dual-credit students, and the delivery of dual-credit coursework after the passage of HB 505. Taken together, the findings from these six areas of investigation provide stakeholders with research-based evidence on the implementation and effectiveness of dual-credit education programs in Texas and inform efforts to ensure that all students are afforded equal opportunities for success in dual-credit education and postsecondary education after high school.

This research was conducted by the American Institutes for Research (AIR) in collaboration with the Texas Higher Education Coordinating Board (THECB). It was funded by the College for All Texans Foundation (CFAT) through generous grants from Educate Texas, a public-private initiative of Communities Foundation of Texas; the Greater Texas Foundation; the Houston

Endowment; and the Meadows Foundation. Any questions should be directed to the principal investigator, Trey Miller, at tmiller@air.org.

Executive Summary

Why Dual-Credit Education Matters for Texas

Dual-credit education, which offers high school students the opportunity to enroll in college-level courses that concurrently confer college and high school credit, can play a critical role in making postsecondary education accessible, affordable, and attainable for all students; but only if it is effective and efficient. Ensuring equitable access to and opportunities for high-quality dual-credit education programs and pathways to postsecondary credentials is particularly consequential in Texas, a state that is increasingly enrolling more low-income students and students of color in the K–12 school system (Texas Education Agency [TEA], 2018). The state has identified dual-credit education as one strategy to increase the number of disadvantaged students earning postsecondary credentials in its strategic plan for higher education, *60x30TX*, in response to the state's demographic changes and the increasing importance of postsecondary education relative to earning a living wage and remaining employed.

Over the years, dual-credit education has become a popular strategy among Texas high schools and higher education institutions (HEIs) to encourage more students to enroll in college and complete credentials. Between 2000 and 2017, the number of high school students taking at least one dual-credit course rose from approximately 18,524 to 225,929, an increase of more than 1,100 percent. At present, 79 of Texas's community colleges (99%), 29 of its universities (59%), and 1,650 of its high schools (93%) provide dual-credit education.

As the number of dual-credit students grows and becomes more diverse, however, and as dual-credit education programs evolve and expand to meet the needs of Texas's ever-changing student population, dual-credit stakeholders have focused increased attention on the quality, efficacy, and cost-effectiveness of dual-credit education programs. Expansion of the scope and reach of these programs, particularly due to recent policy changes resulting from House Bill (HB) 505 (84th Texas Legislature, Regular Session), has led to questions about the academic equivalency of dual-credit courses and college credit-only courses (Education Commission of the States, 2016; Marcus, 2018; Nelson, 2014; Taylor, 2018), the extent to which all students can access and receive high-quality dual-credit education advising (Chang, 2016), and how much dual-credit education costs the state, HEIs and K–12 school systems, and students (Malik, 2018; San Antonio Express-News Editorial Board, 2018).

Providing more rigorous and objective evidence to policymakers regarding dual-credit education programs has become critically important to inform these discussions. Specifically, state and local decision makers have expressed interest in developing a research-based understanding of the effectiveness, benefits, and challenges of dual-credit education programs

and in receiving evidence-based guidance on ways to ensure that dual-credit education programs are administered and scaled effectively. This two-phased study provides Texas policymakers and stakeholders with research-based evidence on the implementation and effectiveness of dual-credit education programs in Texas that can contribute to the statewide and broader nationwide conversation about how to improve dual-credit education as a whole and to ensure that all students are equitably served in dual-credit pathways to postsecondary credentials. This report presents findings from Phase II of the study, which was carried out by the American Institutes for Research (AIR) in collaboration with the Texas Higher Education Coordinating Board (THECB). Study funding was provided by the College for All Texans Foundation (CFAT) through grants from Educate Texas, a public-private initiative of Communities Foundation of Texas; the Greater Texas Foundation; the Houston Endowment; and the Meadows Foundation. Phase I study results were published in an interim report by the RAND Corporation (RAND) in August 2017 (Miller et al., 2017).

Objective of Study

The objective of Phase II was to generate research findings that could drive future efforts to ensure that as many students as possible benefit from effective dual-credit programs. Phase II addresses the research needs of state and local decision-makers on the core issues surrounding dual-credit education in Texas. It expands upon the research conducted by RAND during Phase I that provided an initial appraisal of the outcomes from and implementation of dual-credit education programs to Texas policymakers and practitioners during the 85th Texas Legislature, Regular Session (Miller et al., 2017). To ensure that the study would have the broadest impact on dual-credit education delivered in Texas, Phase II focused primarily on academic dual-credit programs delivered in traditional high schools in partnership with community colleges—the most prevalent form of dual-credit education delivered in the state. However, some components of the Phase II research also lent insights into dual-credit programming and practices in Early College High Schools (ECHSs), career and technical dual-credit education, and dual-credit programs delivered by four-year colleges. We note where Phase II contributes to our understanding of these delivery models throughout this report. Findings from Phase II of the research, which included six study components, provide Texas decision-makers greater insight into the following areas of inquiry:

- The direct effect of dual-credit education programs in traditional high schools relative to college access and completion (*causal impact study*).
- Dual-credit advising practices and procedures (*advising study*).
- Factors that contribute to racial disparities in dual-credit participation (*racial disparities study*).
- The academic rigor of dual-credit courses relative to college credit-only courses (*rigor study*).

- The costs and benefits of delivering dual-credit education (*cost study*).
- Changes in patterns of student participation in dual-credit education, outcomes for dual-credit students, and the delivery of dual-credit coursework after the passage of HB 505 (*HB 505 study*).

Text Box 1.1: Study Methods, Data, and Their Limitations

Phase II employed an array of analytic methods and data sources to investigate each of the study's core topics. Below, we note the methods and data used to investigate each core topic and explain their limitations.

Causal Impact Study

- ***Methods*:** Instrumental Variables combined with Differences-in-Differences and Fixed Effects Methods to control for observable and unobservable factors that influence a student's decision to enroll in dual-credit education, as well as their chances of enrolling in and completing college.
- ***Data*:** Administrative records collected by the TEA and the THECB.
- ***Limitations*:** (1) Excludes Early College High Schools; (2) results are limited to students who decided to take dual-credit education because more students began to take dual-credit education and to dual-credit education delivered before the passage of HB 505; and (3) several factors described in Chapter 1 may bias our estimates, but most plausible factors would cause us to overstate the true effect of dual-credit participation.

Advising Study

- ***Methods*:** Semi-structured interviews.
- ***Data*:** Fifty high school counselors, 51 college advisors involved in dual-credit education advising.
- ***Limitations*:** (1) Observational data was not collected on dual-credit advising sessions, and (2) data is self-reported.

Racial Disparities Study

- ***Methods*:** Ordinary Least Squares (OLS) regression.
- ***Data*:** Administrative records collected by the TEA and the THECB.
- ***Limitations*:** Does not quantify the extent to which certain factors contribute to racial disparities in dual-credit participation; indicates only that they do or do not contribute.

Rigor Study

- ***Methods*:** Descriptive quantitative methods, peer-reviewed rubric adapted by Conley (2013), Marzano & Toth (2014), Webb (2002), and The Wisconsin Center for Education Research (2012a, 2012b).
- ***Data*:** Survey, course syllabi, student assignments, and graded student work collected from high school teachers and college faculty teaching dual-credit courses and from college faculty teaching college credit-only courses in English Composition and College Algebra.
- ***Limitations*:** (1) Results are not generalizable to all dual-credit and college credit-only courses, (2) observational data on the way instructors taught dual-credit versus college credit-only courses were not collected, and 3) a limited number of instructors were included in the analysis.

Cost Study

- ***Methods*:** Ingredients Approach (Levin, 2018).
- ***Data*:** Administrative records collected by the TEA and the THECB, interviews with community college and high school administrators.
- ***Limitations*:** Results limited to academic dual-credit education delivered by community colleges.

HB 505 Study

- ***Methods*:** Descriptive quantitative analyses, OLS regression with high school fixed effects.
- ***Data*:** Administrative records collected by the TEA and the THECB.
- ***Limitations*:** Does not measure the direct effect of HB 505 on student outcomes.

In each subsequent chapter of this report, and in the technical appendices, we detail the methods and data used to conduct each study component.

Overall Finding

Dual-credit education benefits Texas and its students.

This study's overall findings make clear that dual-credit education is a worthwhile investment for Texas high school students and the state of Texas. Findings from Phase II also highlight areas in which policies and practices can improve to help ensure that dual-credit education benefits all participating students in the future.

Specific Findings

The benefits generated by dual-credit education greatly exceed the cost of its delivery.

Dual credit costs have not been studied in Texas since 2011, and our study provides one of the most comprehensive analyses that have been completed nationally to date. Overall, our estimates suggest that, on average, the monetary benefits generated by dual-credit education are five times the costs of program delivery, over and above the costs of program delivery at the high school level. The bulk of dual-credit education benefits come from the increased postsecondary educational attainment of dual-credit students, which leads to increased lifetime earnings for individuals and social benefits for the state, such as decreased governmental spending on social programs and increased tax revenues. The other source of benefits from dual-credit education is a reduction in time to degree for individuals completing a four-year degree. This benefit leads to a reduction in college spending and earlier entry into the workforce. In total, the combined lifetime benefits of higher education attainment and benefits from reduced time to degree are more than five times the cost of providing dual-credit instruction.

Dual-credit education boosts college enrollment and completion, especially in the context of two-year institutions.

Overall, findings from the causal impact study demonstrate that students generally benefited from participating in dual-credit education. After controlling for differences between dual-credit students and nondual-credit students, such as their academic backgrounds, drive to succeed, and the types of high schools they attended, we found that dual-credit education directly increased college enrollment by 2.4 percentage points and college completion by 1.1 percentage points. These improvements were mostly a result of a higher percentage of students enrolling in two-year colleges and completing workforce certificates or associate degrees. Dual-credit education programs also reduced the amount of time students invested in pursuing postsecondary degrees by about one summer term. The results reflect the effectiveness of dual-credit education relative to improving college access and success before the Texas Legislature passed HB 505 in 2015.

It is important to note that although these estimates are lower than what existing studies report (Giani, Alexander, & Reyes, 2014; Kim & Bragg, 2008; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018), they are a more accurate measure of the academic benefits of dual-credit education programs. The greater accuracy is a result of the methodology used to produce estimates, which controls for a wider range of student and high school characteristics that influence not only the probability that a student would enroll in dual-credit education, but also how well a student would perform in high school and college. Without adequately controlling for the observable differences (e.g., race and ethnicity, low-income status, the high school the student attended) and unobservable differences (e.g., "grit") between students who take dual-credit courses and those who do not, it is impossible to isolate the direct effect of dual-credit education programs from other factors, such as academic ability and drive, on student short- and long-term outcomes. These causal estimates are in line with results from a recent quasi-experimental study measuring the impact of dual-credit education in Texas by Villareal (2017), as well as other impact studies examining the effect of Advanced Placement (AP) courses on similar measures of student success using Texas data (Jackson, 2010, 2014; Klopenstein & Thomas, 2009).

Evidence suggests that dual-credit courses are equally as rigorous as college credit-only courses.

Although based on a limited set of College Algebra and English Composition courses delivered for dual-credit and college credit only, our findings reflected more commonality than differences in the ways instructors taught these two types of college-level courses. Specifically, we found that instructors teaching dual-credit courses and those teaching college credit-only courses delivered similar content, developed similar student assignments, and assessed student responses to those assignments using similar metrics and standards. College Algebra and English Composition are two of the most common college-level courses taught for dual credit.

Areas That Merit Attention

While this study finds evidence suggesting that dual-credit education works to increase college enrollment and completion, it also unearthed three specific areas of dual-credit education that merit attention.

Low-income students and students of color benefitted less from dual-credit education delivered in a traditional high school setting when compared with affluent and White students.

Our quantitative results show that lower levels of academic preparation hinder regular dual-credit education programs from equalizing postsecondary education access and success between traditionally advantaged and disadvantaged students. Based on data from the THECB and the TEA, we identified lower levels of academic preparation—measured by eighth-grade standardized test scores in reading and mathematics—as the primary factor explaining these gaps. Existing research highlights other potential factors that also may serve to widen disparities between traditionally advantaged and disadvantaged students. For example, Castleman, Page, and Schooley (2014) report that low-income students and students of color have fewer mentors or college-educated family members, making it difficult for them to navigate the complexities of college. Other evidence states that these student populations, in particular, encounter environmental stressors that can negatively affect learning and academic success (Hopson & Lee, 2011). Taken together, these findings suggest that academic preparation and adequate supports are critical for helping disadvantaged students benefit from dual-credit education.

Evidence suggests that costs may be a barrier to access dual-credit education.

Findings from various components of Phase II suggest that lacking financial resources to enroll in dual-credit courses can be an obstacle to dual-credit education access. Results from the racial disparities study showed that income explained a significant share of the gap in dual-credit participation across race and ethnicity. Also, high school guidance counselors and college advisors who participated in the advising study reported that the cost of tuition and textbooks often deters students from considering and pursuing dual-credit education. Our cost analysis showed that although many community college partnerships absorb all or part of tuition costs for low-income students, some do not. Even when students do not have to pay tuition and fees to enroll in dual-credit courses, they may still have to pay for textbooks and materials required by their instructors, which could amount to hundreds of dollars.

Constraints faced by high school counselors and college advisors compromise the quality of advising that dual-credit students receive.

This study shows that college advisors and high school counselors experience challenges in ensuring that dual-credit students enroll in courses that follow a coherent and efficient educational pathway to a degree. Data collected from the advising study demonstrated that advisors and counselors often lack the supports and information needed to help ensure dual-

credit students can transfer credits toward the requirements for their major. Compounding this problem, data also show that high school counselors were on the front lines of advising dual-credit education students. The concern is not that high school guidance counselors play a primary role, but that they often lack the resources, time, and knowledge necessary to provide advising through the lens of a college perspective. Certainly, high school counselors are invaluable in ensuring that dual-credit students stay on track to satisfy their high school graduation requirements; however, college advisors typically have more experience, insight, and access to information about credit-transfer policies that could help steer students away from courses that could lead to excess credit.

Study Recommendations

If Texas intends to meet the goals of *60x30TX,* the state must ensure that dual-credit education programs benefit all students, particularly those who face formidable challenges accessing, completing, and affording college. These recommendations, which are based on the results of this study, offer stakeholders guidelines on how to strengthen and improve dual-credit education as it continues to expand and evolve to meet the needs of an increasingly diverse student population.

Ensure that students are adequately prepared to succeed in and have the necessary supports to benefit from dual-credit education programs delivered in traditional high schools.

Our study suggests that academic preparation is important for ensuring student success in dual-credit programs delivered in traditional high school settings. Results from the causal impact study demonstrated that, on average, students of color and low-incomes students benefitted less from participating in dual-credit education than their counterparts, in part because they had lower scores on eighth-grade reading and mathematics standardized tests. Notably, for disadvantaged students who achieved test scores one standard deviation above the average score, participating in dual-credit programs delivered in traditional high school settings improved a range of college outcomes. This finding is promising and shines yet another spotlight on the urgent need to close persistent student subgroup gaps that too often emerge and grow during students' elementary and secondary pathways.

Our evidence points to lower academic preparation as one way to explain disparities in college access and completion among dual-credit students. Other research, however, suggests additional factors are at play that our study was not able to fully investigate. For example, many studies suggest that low-income students and students of color have fewer college-educated

family members and mentors who can help them navigate the complexities of college (Castleman, Page, & Schooley, 2014; Rall, 2016). Furthermore, other studies show that students of color and lower income students encounter formidable challenges and life stressors, such as taking care of younger siblings and working multiple jobs to support their families, that make accessing and succeeding in college an even more difficult endeavor (Hopson & Lee, 2011). Dual-credit programs should be designed and structured to meet the academic, informational, and financial needs of students in these circumstances to enable a greater number of secondary students to realize the benefits of participating in college-level coursework.

In addition, the results of our advising study suggest that students attending Early College High Schools (ECHSs) have greater access to these types of supports than students in traditional high schools as they navigate dual-credit courses and pathways into college. This finding is consistent with experimental research on ECHSs, suggesting that dual-credit education programs that embed strong student services, such as regular tutoring and intrusive advising, show promise in supporting students who have been traditionally underserved by the K–12 education system (Edmunds et al., 2010; Edmunds et al., 2012; Edmunds et al., 2017). Identifying which student supports efficiently and effectively increase the success of traditionally underserved students enrolled in dual-credit education is an area that merits attention and further research, particularly in light of the continuing expansion of dual-credit education programs in Texas.

Strive to guarantee that costs neither serve as barriers for students to participate in dual-credit education nor inhibit higher education institutions from offering affordable, high-quality dual-credit education programs.

High school guidance counselors reported that the costs of tuition, fees, and books were barriers to dual-credit participation, and our results indicate that income plays a role in the gap in dual-credit participation across race and ethnicity. This suggests that the costs of delivering dual-credit education programs, when shifted to students, may weigh heaviest on low-income students and their families. Furthermore, we found that when community colleges cover the cost of tuition and fees in order to make dual-credit education affordable, they absorb the bulk of the total annual costs (77%), which far exceeds the state-appropriated formula funding they receive for dual-credit. Absent the ability to rely on other revenue streams to make up that difference, even the best-resourced institutions and districts may reach a point at which offering tuition and fee waivers to dual-credit students becomes unsustainable. While charging students tuition and fees to cover a proportion of delivery costs is reasonable to keep dual-credit programs afloat, it may come at the expense of broadening access to dual-credit

education. Left unchecked, these issues could jeopardize the sustainability of dual-credit programs and increase the cost of dual-credit education for students, exacerbating inequities in dual-credit participation by race, ethnicity, and income. However, when considering ways to boost funding for dual-credit programs to address these issues, policymakers should consider trade-offs with respect to other uses of scarce state resources.

Continue to close gaps in dual-credit participation rates across race and ethnicity.

Texas has made considerable progress in increasing the rate at which students of color participate in dual-credit education. However, a significant gap in participation rates by race and ethnicity persists. As mentioned previously, our analyses suggest these disparities are driven by differences not only in levels of academic preparation, but also income and the types of high schools that students attend.

To narrow these disparities, stakeholders should invest in initiatives—starting as early as elementary and middle school—that level the playing field of postsecondary opportunity for all students, regardless of their resource levels or degrees of college exposure. Colleges and school districts must also ensure that efforts to close gaps in dual-credit participation do not unintentionally encourage academically underprepared high school students to enroll in dual-credit education if schools are unable to provide robust academic services and supports to these students. Continuing to scale effective and well-implemented ECHS programs that are targeted at disadvantaged students could play a vital role in helping the state to close the participation gap while also ensuring that disadvantaged students benefit from dual-credit programs.

Encourage institutions to continue developing and implementing processes to ensure dual-credit courses remain as rigorous as college credit-only courses.

Our study found encouraging evidence regarding the rigor of dual-credit courses compared with courses taught for college credit only. We collected detailed course materials, including graded student assignments, from instructors of College Algebra and English Composition courses, and we found few differences between dual-credit and college credit-only versions of those courses. Our study was limited in that we had the resources to look only at two courses delivered by a small number of instructors. More work is needed to show that all dual-credit courses are as rigorous as college credit-only courses. However, findings from our study provide evidence that may negate concerns that dual-credit courses as implemented in Texas are less rigorous than college credit-only courses being delivered at community colleges.

Nevertheless, it is important to emphasize that two- and four-year colleges should continue monitoring and assessing the academic rigor of dual-credit courses to ensure that students

benefit from dual-credit education and are prepared to meet the expectations and rigors of college credit-only courses when they enter postsecondary degree programs. One approach to ensuring equivalence in academic rigor could involve the development of common assessments (i.e., assignments and tests) that would be administered to dual-credit and college credit-only students and that would assess differences in performance on those assessments between both student groups. Another approach could involve using college credit-only and dual-credit instructors to jointly grade dual-credit student assignments and tests based on academic benchmarks set for college credit-only courses. Finally, we encourage practitioners to draw from the rubric we developed for this study to assess similarities and differences between dual-credit and college credit-only courses for content, student assignments, and grading standards.

Improve the advising processes and ensure equitable access to high-quality advising for dual-credit students.

Our study suggests that the quality of advising could be enhanced if dual-credit partnerships engaged in several efforts. First, high school guidance counselors should more directly engage with college advisors in guiding the course choices of dual-credit students. Although typically on the front lines of providing advising to dual-credit education, counselors reported they had few opportunities to participate in training about dual-credit education and that their abilities to effectively advise students would be enhanced by more specific guidance on advising dual-credit students.

Similarly, college advisors rarely reported receiving any dual credit-specific training, and some suggested that joint training opportunities with their high school counterparts could help clarify roles and responsibilities and streamline and improve the counsel given to students and their families. Respondents in our advising study also highlighted the benefits of students hearing directly from college advisors, noting that guidance from college advisors tends to bear more weight in students' course-taking decisions. Directly involving college advisors in the advising of students—who have more experience, insight, and access to information about credit-transfer policies—to a greater degree is one way to provide support to high school counselors engaged in guiding dual-credit students and ensuring that high school students make smart choices about pursing dual-credit opportunities and taking dual-credit courses.

Second, colleges and high schools should start advising potential dual-credit students early. Early advising could involve creating opportunities for students to explore postsecondary options, including potential degree and career pathways, particularly for students who have the option of dual-credit education as early as their ninth- or 10th-grade years.

Introduction

Increasing enrollment and graduation rates in higher education, particularly among historically underserved students, represents an enduring challenge among educators and policymakers. Although evidence shows that college has become more accessible to low-income students and students of color over time, the college enrollment rate for these students has not grown at a rate comparable to that of traditionally more advantaged students (Perna, 2006). This widening gap has led to an overwhelming consensus among policymakers, practitioners, and researchers that not enough improvement has been made relative to college enrollment among disadvantaged students (Perna, 2006). What is even more troubling is that the overall U.S. college enrollment rate has recently declined (National Student Clearinghouse Research Center, 2017), and racial and ethnic disparities in college completion are widening (Pfeffer, 2018), despite efforts to make college more affordable and more responsive to student needs. While some states, like Texas, have managed to increase college enrollment and completion among students who are less likely to enroll in college (e.g., low-income students), continuing increases in the number of less-resourced residents have highlighted a need to develop specific interventions to help future students pursue and finish higher education.

Identifying and scaling what works to guide more traditionally underrepresented students to and through college has been a challenge for policymakers. One theory of why interventions have failed to achieve expectations cites a lack of coherence between secondary and postsecondary education systems (Kirst & Venezia, 2004). Indeed, numerous scholars have identified the misalignment of academic standards, curricula, assessment, pedagogy, and expectations between high schools and colleges and universities as putting students at risk of failing to succeed in college (Carnevale & Desrochers, 2002; Goldrick-Rab, 2010; Harvey & Houseman, 2004). Low-income students and students of color are disproportionately affected because they have fewer resources to draw upon to address this disparity (Dounay, 2008).

Dual-credit education is one alternative to business-as-usual practice that has the potential to integrate secondary and postsecondary sectors, widen college opportunities, and boost college completion as a result. Dual-credit education programs, which are jointly delivered by high schools and postsecondary education institutions, concomitantly award high school and college credit to high school students who enroll in college-level coursework (Bragg & Kim, 2005).

While originally developed to provide academically challenging content to high-achieving students, dual-credit education programs across the United States now enroll high school students with varying degrees of academic preparation and exposure to college and with an

array of postsecondary education goals and expectations. In 2013, the U.S. Department of Education reported that four of five U.S. high schools offered at least one dual-credit course (Thomas, Marken, Gray, & Lewis, 2013), illustrating that access to this intervention has become widespread across U.S. secondary schools. Bailey, Hughes, and Karp (2002) contend that the strong link between rigorous academic coursework and success in higher education has served as an impetus for enrolling mid-range and lower achieving students in dual-credit coursework.

About This Report

This report presents findings and offers key takeaways from the second phase of a two-year study on dual-credit education programs in Texas. Phase II extends research conducted by the RAND Corporation (RAND) in Phase I that, during the 86th Texas Legislature, Regular Session (2017), provided Texas policymakers and practitioners with an initial appraisal of the effectiveness and implementation of dual-credit education programs.

Phase II, conducted by the American Institutes for Research (AIR) in collaboration with the THECB, included a more in-depth analysis of dual-credit education programs than Phase I, specifically investigating core issues at the heart of current debates regarding dual-credit education in Texas, a state that has rapidly scaled dual-credit education programs. This report builds on the Phase I study's findings to provide Texas decision makers greater insight into questions about (1) the impact of dual-credit education programs on college access and college completion; (2) the quality of advising and the rigor of academic content, instructional strategies, and assessment practices relative to dual-credit programs; (3) the costs of delivering dual-credit education; (4) factors that contribute to racial disparities in dual-credit participation; and (5) changes in patterns of student participation in dual-credit education, the outcomes of dual-credit students, and the delivery of dual-credit coursework after the passage of legislative efforts to expand access to dual-credit education programs.

The focus of this study is on "traditional": academic dual-credit education delivered by community colleges. Consequently, results from Phase II provide less insight into the effectiveness and implementation of Early College High Schools (ECHSs), career and technical dual-credit education, and dual-credit education delivered by four-year universities and colleges. Findings developed during Phases I and II of this study provide Texas policymakers and stakeholders a more informed understanding of dual-credit education and will offer an evidence-based roadmap to guide reform intended to improve the effectiveness and cost-efficiency of dual-credit programs.

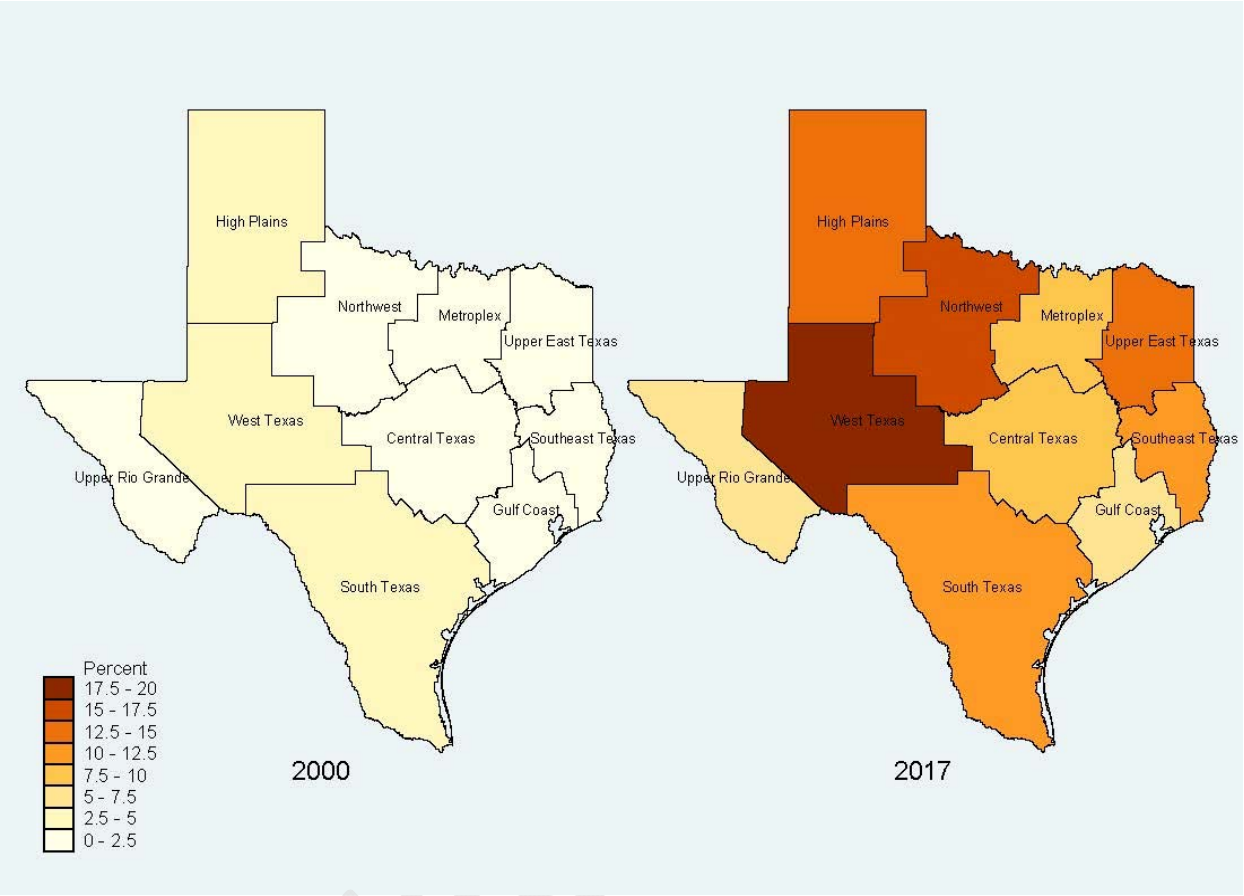
In the narrative that follows, we provide a brief overview of the dual-credit education landscape in Texas and describe Texas' definition of dual-credit. We also identify the issues at

the core of the current debate surrounding dual-credit education in the state. We then summarize findings from Phase I research conducted by Miller and colleagues (2017) and describe the research conducted during Phase II. Chapters 2 through 4 present the findings from Phase II, and the report concludes with a synthesis of findings from both study phases.

Overview of Dual-Credit Education in Texas

Since 2000, Texas has witnessed a notable increase in the number of high school students enrolling in dual-credit education programs and in the number of public higher education institutions (HEIs) delivering dual-credit education in partnership with public high schools. Between 2000 and 2016, the count of high school students taking at least one dual-credit course rose from approximately 18,524 to 204,286, an increase of more than 1,100%. During the same period, the number of HEIs delivering dual-credit education increased from 52 to 108. At present, 79 community colleges (99%), 29 universities (59%), and 1,650 high schools (93%) provide dual-credit education in Texas. Figure i.1 visually depicts demonstrable growth in student participation in dual-credit education.

Figure i.1 Dual Credit Participation Rate by Region, 2000 and 2017



Two major factors explain why dual-credit education has scaled so quickly in Texas:

- Since 1995, Texas has enacted legislation making it easier for students to participate in dual-credit courses and for HEIs to offer dual-credit education programs. The architects of these laws not only created explicit funding streams for the delivery of dual-credit courses but also required high schools to offer students the opportunity to take at least 12 hours of advanced coursework that may include dual-credit courses. In 2015, the Texas legislature took an additional step to broaden access by passing HB 505, a bill that prohibits THECB from limiting dual-credit participation exclusively to high school juniors and seniors and from limiting the number of dual-credit courses a student can take while enrolled in high school. Nevertheless, HEIs and school districts still can implement these restrictions if they

wish to do so. Based on data from fiscal year 2017, roughly half (1,545) of institutional partnerships delivered dual-credit education to ninth- and 10th-grade students.[1]

- Higher education institutions, particularly community colleges, have taken advantage of new laws expanding access to college-level coursework. Many institutions promote dual-credit education as a promising strategy to increase college access and completion rates. Advocates have drawn on existing research to successfully argue that dual-credit education addresses many barriers that prevent students from accessing and succeeding in college. They argue that dual-credit education exposes students to the academic and behavioral demands of college, offers an opportunity to align curricula and content standards across secondary and postsecondary education by increasing communication and collaboration between the two sectors, and saves students time and money relative to degree attainment (Bailey et al., 2002; Edwards & Hughes, 2011; Hoover & Vargas, 2016).

Defining Dual-Credit Education in Texas

THECB defines dual-credit education as "a process by which a high school student enrolls in a college course and receives simultaneous academic credit for the course from both the college and the high school" (Texas Administrative Code [TAC], Title 19, Part I, Chapter 4, Subchapter D, Rule 4.83). This definition includes the different ways in which dual-credit education is implemented in practice. For example, we know from the Phase I study that HEIs delivered dual-credit education programs on high school and college campuses using high school teachers and college faculty and through both face-to-face and online instruction among other approaches. In Texas, institutions also administer dual-credit education programs in ECHSs, which, according to the Texas Education Agency (TEA), are secondary institutions that offer dual-credit courses that can lead to either an associate degree or at least 60 semester credit hours toward a baccalaureate degree for ninth-, 10th-, 11th-, and 12th-grade students at risk of dropping out of high school. To be considered enrolled in a dual-credit education program, dual-credit partners (i.e., the high school and the HEI) must confer *both* high school and college credit for performance in a dual-credit course. Partnerships that award either high school or college credit (but not both) for college-level coursework are not defined as dual-credit programs according to Texas law.

[1] It is important to note that this statistic does not reveal the amount of dual-credit education delivered to ninth- and 10th-grade students. For more information about dual-credit dosage, please refer to Technical Appendix A.

Discussions Around Dual-Credit Education in Texas

Texas policymakers and practitioners have begun to express reservations about whether dual-credit education can deliver on its promise to narrow gaps in college enrollment and completion. Chief among these concerns is the long-held assumption that dual-credit courses are not as academically rigorous as college credit-only courses. Some dispute the notion that dual-credit instructors can or will teach courses at a level of rigor equal to that of college-level courses, given that they face enormous pressure to graduate high school students to meet accountability mandates.

In addition, some concerned stakeholders question whether all high school students are academically and emotionally prepared to meet the performance criteria of college-level courses; and many have questioned how dual-credit partners select students to participate in dual-credit education programs, how they advise students regarding academic and career and technical dual-credit courses, and the extent to which high school students benefit academically from such educational programming. Because Texas does not have a uniform model to fully fund the implementation of dual-credit education programs, lawmakers also seek basic knowledge about who bears the costs of delivering dual-credit education and the extent to which stakeholders are being adequately compensated for their investment.

Summary of Phase I Findings

In July 2017, RAND published findings from Phase I of this study in an interim report on dual-credit education programs in Texas. For that report, Miller and colleagues (2017) conducted descriptive quantitative and qualitative analyses examining four focal areas of dual-credit education of interest to dual-credit stakeholders. Those areas of focus included: (1) academic achievement and degree attainment of dual-credit students versus nondual-credit students, (2) participation of different student groups in dual-credit education programs, (3) instructional and advising practices of community colleges that deliver dual-credit education, and (4) the number of credits and semesters in which dual-credit students enroll to earn a bachelor's degree. Key findings from the study's Phase I research are summarized below.

High school graduates who participated in dual-credit education programs outperformed students who did not.

- Measures of performance included grades in dual-credit courses and follow-on college credit-only courses, college remediation, enrollment, persistence, and completion.

Instructional and advising practices used to deliver dual-credit education programs were not uniform and varied across community colleges.

- Resource constraints, geographic proximity to high schools, and institutional latitude over academic matters contributed to differences in delivery approaches.

Despite notable gains among historically underserved student groups, disparities in dual-credit education by race/ethnicity, income, gender, and academic background persisted over time.

- Traditionally advantaged students (e.g., Whites, gifted, academically talented) stood a much greater chance of participating in dual-credit education than historically disadvantaged students (e.g., Black, Hispanic, economically disadvantaged).

Dual-credit students did not progress more efficiently toward a bachelor's degree than nondual-credit students.

- High school graduates who participated in dual-credit education took about 142 credits, including credits earned in dual-credit education programs, to complete a bachelor's degree. That average was similar to the number of credits earned by high school graduates who did not enroll in dual-credit education. Nevertheless, dual-credit students generally graduated one semester sooner than did their nondual-credit peers.

Overview of Phase II

Objective of Phase II Research

In April 2017, AIR was awarded funding to conduct Phase II of this research. The purpose of Phase II was to examine areas of dual-credit education that Phase I was unable to explore but that remained of interest to Texas state and local education decision makers. Unlike the fast turnaround (approximately six months) and relatively narrow research focus of the study's first phase, Phase II was conducted over the course of a year and included six specific study components: (1) a causal impact study, (2) a racial disparities study, (3) an advising study, (4) an academic rigor study, (5) a cost study, and (6) an HB 505 study. In its design, Phase II intentionally provided stakeholders a more in-depth understanding of how well dual-credit education programs were working, how they were delivered to students in practice, and who bore the costs of delivering dual-credit education. Decision makers will be able to link the overall effectiveness and cost of dual-credit education with specific features of how dual-credit

programs are delivered by connecting the results of all six components. This, in turn, will facilitate the identification of areas in need of support or reform.

Dual-Credit Approaches Included in Phase II

Phase II primarily focused on investigating academic dual-credit education delivered in traditional high schools by community colleges. We took this approach for several reasons.

First, dual-credit education focused on teaching academic content and delivered in traditional high schools by community colleges is the most common type of dual-credit education found in Texas. Dual-credit education delivered in ECHSs, focused on career and technical education (CTE), or delivered by four-year institutions is less prevalent. According to THECB data, 17% of dual-credit students were enrolled in an ECHS, 11% of dual-credit students participated in CTE dual-credit education, and 6% of dual-credit students participated in dual-credit education delivered by Texas public four-year institutions during the 2017 fall semester. This study focuses on the most common approach of delivering dual-credit education in Texas to provide research that can potentially have the broadest impact.

Second, at the time that AIR began to design research for Phase II, rigorous research already existed on the impact of ECHS on a wide range of student outcomes (Edmunds et al., 2010; Edmunds et al., 2012), and the University of Texas (UT) System (2018) was beginning its own study focusing on dual-credit students matriculating in UT System, four-year academic institutions. While we focused our study's causal impact component on traditional high school dual-credit programs, we included examinations of dual-credit education programming and practices in ECHSs, CTE dual-credit education programs, and within the context of four-year institutions in other components of our study in which research gaps remained.

Finally, it is important to note that the three less prevalent approaches mentioned above deliver dual-credit education in ways that differ markedly from traditional high school delivery modes. For example, to be approved to deliver dual-credit education in an ECHS by the TEA, dual-credit education partners must submit an application that meets the design elements of a TEA-designated ECHS, which includes targeting students at-risk of dropping out of high school and providing robust student supports (e.g., tutoring, intrusive advising). Similarly, the costs of delivering CTE dual-credit education programs are different than the costs of delivering academic dual-credit education programs in that many CTE dual-credit programs hire industry leaders and require equipment for purposes of instruction. We would have required more time and resources to thoroughly examine and be able to provide useful and accurate information on these programs.

However, we want to emphasize that several components of this study collected data on these less-prevalent models where resources and data were available, and we note where the different dual-credit delivery modalities were included in our analyses in Table i.1 below.

Table i.1. Modes of Dual-Credit Education Delivery Examined in This Study

Institution Type	Causal Impact Study	HB 505 Study	Racial Disparities Study	Rigor Study	Cost Study	Advising Study
Two-Year Colleges	X	X	X	X	X	X
Four-Year Colleges	X	X	X	X		X
ECHS		X	X	X	X	X
CTE Dual Credit	X	X	X			X

Phase II Research Methods

Phase II was a multicomponent study that employed the concurrent mixed-model design approach. This design allowed the research team to conduct parallel quantitative and qualitative studies that, together, will help decision makers understand the relationships between several aspects of dual-credit education, such as its effectiveness and the ways it is delivered to high school students. To answer research questions (RQs) from Phase II, AIR drew on a range of analytical techniques and data sources. In each of the subsequent chapters of this report and in the technical appendices, we detail the methods and data used to conduct each study component.

How Phase II Research Questions Addressed Current Knowledge Gaps

Phase II was designed to answer six RQs designed to expand knowledge about dual-credit education in Texas beyond what was investigated in Phase I. Below, we list these RQs in the order in which they are presented in the report and briefly describe the knowledge gaps that motivated them, as well as the methods we used to answer them.

RQ 1: To what extent did dual-credit education increase college enrollment, credential attainment, and efficient degree completion?

Phase I found that, on average, dual-credit students outperformed students who did not participate in dual-credit education programs on a wide range of achievement measures. Generally, Texas high school students must meet various eligibility criteria to enroll in dual-credit education. Thus, students who participate in dual-credit education programs probably differ from those who do not. For example, Phase I discovered that dual-credit students were more likely to

be identified as gifted, academically talented, and White than were nondual-credit students. Because Phase I did not account for differences between dual-credit and nondual-credit students, estimates measuring the effect of dual-credit education on student success captured not only the effect of dual-credit education but also the effect of individual characteristics that influence how well a student performs in school. Consequently, these measures do not describe the true impact of dual-credit education on college access and college completion.

To assess the extent to which dual-credit education—independent of other factors—affected the chances of a given student achieving academic milestones and reaching them more efficiently, AIR employed a more rigorous research method; specifically, the instrumental variable approach embedded with a difference-in-different framework. Drawing on THECB and TEA administrative data across 16 student cohorts, AIR examined the extent to which improvements in high school and college degree attainment, college enrollment, and efficient degree completion over time occurred in precise relation to when a high school began offering dual-credit courses. AIR started with the cohort of students who were in their junior year of high school in 2000. As part of the analysis, AIR also examined the extent to which participation in dual-credit education had differential impacts on student outcomes for students with varied demographic and academic backgrounds (e.g., race/ethnicity, free or reduced-price lunch status, gifted and academically talented).

Because insufficient time has passed to measure the effectiveness of dual-credit programs since the enactment of HB 505, findings from this analysis apply specifically to dual-credit education programs implemented before 2015. Moreover, our econometric approach required us to exclude dual credit delivered through ECHSs from this component of the study. We do not view this as a major limitation, since numerous rigorous studies that have included ECHS programs in Texas have documented the benefits of ECHS for a wide range of students, including those who are traditionally underrepresented in postsecondary education.

RQ 2: How did high school counselors and college advisors select students for dual-credit education, advise them into enrolling in dual-credit courses, and coordinate advising services?

Because Texas law does not prescribe how HEIs should advise dual-credit students, models of dual-credit advising vary considerably. Qualitative research conducted during Phase I found that some community colleges that delivered dual-credit education relied on high school counselors to advise dual-credit students, while other community colleges employed college advisors. Phase I also found that the degree to which college advisors interacted and engaged with dual-credit students and their families differed depending on resource constraints, geographic proximity to the high school, and the types of courses colleges offered dual-credit students.

Based on Phase I research, it is difficult to discern the extent to which these different approaches adequately support dual-credit students as they navigate the complexities of college. To address this knowledge gap, AIR conducted in-depth, semistructured interviews with high school guidance counselors and college advisors working with dual-credit students in dual-credit education partnerships that represented the full spectrum of models delivered across the state. These interviews collected information on a range of topics that accurately characterized partnerships' advising approaches and solicited suggestions for how to improve advising processes. The interviews specifically addressed (1) the types of students who were targeted for dual-credit education; (2) the roles of high school guidance counselors and college advisors and how they worked together to coordinate advising activities; (3) the factors that high school counselors and college advisors considered when counseling students regarding specific dual-credit courses; (4) the challenges that dual-credit advisors or counselors encountered when counseling dual-credit students; and (5) suggestions from high school counselors and college advisors for improving dual-credit student advising.

It is important to note that we designed the advising study to include a broad range of dual credit partnerships, including ECHSs, DC delivered by two- and four-year colleges in both urban and rural settings, and DC programs that deliver a significant number of CTE dual-credit courses. However, the study provided richer information about advising for academic DC courses delivered by two-year colleges, since such courses represent the vast majority of DC courses delivered in the state.

RQ 3: How were dual-credit students taught and assessed relative to college credit-only students?

Institutions have considerable latitude over how they deliver dual-credit instruction. Phase I of this study found that colleges employed a higher percentage of high school teachers to teach college courses that counted for dual-credit versus those courses counting for college credit only. Further, Phase I discovered that instructors who taught dual-credit courses were more likely to be adjunct professors and were less likely to hold doctoral degrees compared with instructors who taught college credit-only courses.

How do these differences affect the quality of instruction that dual-credit students receive, and to what extent is dual-credit instruction on par with college credit-only instruction in terms of academic rigor? To address these questions, we examined content, instructional strategies, student assignments, and graded student work across three course types: (1) dual-credit courses taught by high school teachers (2) dual-credit courses taught by college faculty, and (3) college credit-only courses taught by college faculty. For this analysis, AIR focused on two

common courses taken by dual-credit students: College Algebra (Math 1314/1414) and English Composition (English 1301). Using a rubric vetted by content and curriculum experts, AIR assessed the extent to which there were systematic, discernible differences in the rigor and quality of dual-credit versus college credit-only materials, including syllabi, student assignments, and graded work products (e.g., examinations, assignments, portfolios). In addition, AIR administered an instructional survey to participating teachers and faculty to collect information on the use of instructional practices across HSDC, DC, and CC courses.

It is important to note that this component of the study focused only of dual-credit and college credit-only courses delivered by community colleges and does not distinguish between courses delivered through ECHSs versus regular dual-credit partnerships.

RQ 4: What were the annual costs of delivering dual-credit education, and how were they distributed among stakeholders? Also, how did these costs compare to the benefits of dual-credit education?

A key limitation of the Phase I research was its inability (due to the defined parameters of its focus) to investigate costs related to the delivery of dual-credit education programs. In Texas, both HEIs and school districts receive formula funding to deliver dual-credit education; but they also rely on other financial sources (e.g., students, families, communities) and employ different staffing structures to support the administration of those programs. Texas lawmakers lack evidence on whether state and local funding sources for HEIs are sufficient to account for the additional costs that HEIs incur through dual-credit education or whether the state's investment in dual-credit education provides monetary returns that exceed associated costs.

Phase II shed light on this issue by estimating the overall cost of delivering dual-credit education in the state. It did so by calculating how the cost of delivering dual-credit education was shared among a variety of stakeholders and by conducting an analysis that compared costs of delivering dual-credit education against the monetizable benefits derived from dual-credit programs. In carrying out this study, AIR relied on a mix of data sources, including THECB and TEA administrative records; dual-credit Memoranda of Understanding (MOUs); and interviews with HEI, school district, and high school administrators to uncover the visible and hidden costs of delivering dual-credit education.

The cost study focused only on academic dual-credit courses delivered by community colleges, so the findings cannot speak to the costs of CTE dual credit. However, we included a sufficient number of ECHSs in our sample to estimate the costs of DC delivered through regular DC partnerships versus ECHSs. While we purposefully included DC partnerships that deliver DC

courses to rural high schools in our sample to make the cost estimates more reflective of the state as a whole, we are unable to provide separate cost estimates for DC delivered in urban versus rural settings.

RQ 5: Which factors contributed to racial and ethnic disparities in dual-credit participation?

Quantitative analyses conducted during Phase I showed that students of color (e.g., Black and Latino students) were less likely to participate in dual-credit courses compared with White students, even though students in that group experienced the largest gains in dual-credit participation since 2000 among all student groups. These data raised an important question: Why are students of color participating in dual-credit programs at lower rates than White students? Phase II answered this question by drawing on TEA and THECB administrative records to examine the extent to which the following factors could explain these participation rates:

- Differences in the preparation and demand for dual-credit education across demographic groups.
- Access to dual-credit education and alternative forms of advanced coursework (e.g., Advanced Placement [AP], International Baccalaureate [IB]) across high schools.
- The influence of advising practices on dual-credit participation gaps.

The interviews conducted with high school guidance counselors and college advisors as part of the advising component of the study also were used to explore whether implicit bias or discrimination in advising practices might have contributed to these disparities.

RQ 6: What were the patterns in dual-credit participation, success, and delivery before and after HB 505?

Passed in 2015, HB 505 prohibited the state from limiting access to dual-credit education to juniors and seniors or from restricting the number of dual-credit semester credit hours high school students could take. Since then, lawmakers have expressed concern that the rules around who can participate in dual-credit education programs have become too lax, allowing students who are not academically or emotionally prepared to enroll in dual-credit education to do so. Although Phase I descriptively examined changes in dual-credit participation and delivery, as well as the outcomes of dual-credit students, it did so using data compiled only prior to fiscal year 2015. As such, Texas lawmakers had a minimal understanding of whether there were any changes in dual-credit participation, success, and delivery since passage of HB 505.

AIR filled this information gap by drawing on THECB and TEA administrative data to specifically examine the extent to which current dual-credit participation rates overall, by grade, and by various student characteristics (e.g., race/ethnicity, academic background) have changed since passage of HB 505. Complementing this analysis, AIR also investigated changes in college enrollment, course performance, and college completion, as well as the average number of dual-credit semester credit hours with which a student matriculated to complete a four-year degree.

The Role of THECB in Phase II Research

AIR is strongly committed to connect research to improve education policy and practice. Our researchers and technical consultants work closely with state policymakers and local practitioners to identify problems of policy and practice, as well as to address their research needs. In partnership with THECB, AIR determined dual-credit education to be a matter of interest, and THECB staff contributed their expertise to properly contextualize results and to ensure that the study could inform the Board's legislative recommendations. In addition, THECB staff facilitated access to administrative data collected by the Board and the TEA, supported AIR efforts to collect data, and collected MOUs from Texas dual-credit partnerships. To avoid compromising the objectivity and integrity of the research, however, THECB was not involved in designing the study, gathering primary data, or analyzing primary or secondary data.

Roadmap of This Report

This report is divided into five chapters. Chapter 1 presents research conducted to examine (1) the impact of dual-credit education programs on student outcomes and efficient degree completion, (2) the factors contributing to racial and ethnic disparities in dual-credit education participation, and (3) changes in dual-credit education occurring since passage of HB 505. Chapter 2 examines how students were advised relative to dual-credit education programs and how they were guided through dual-credit education coursework, as well as how HEIs and high schools worked together to deliver dual-credit advising. Chapter 3 examines how dual-credit students are taught and assessed relative to college credit-only students. Chapter 4 quantifies the costs of delivering dual-credit education, explains how these costs are shared among stakeholders, and describes the costs of delivering dual-credit education compared with its benefits. Chapter 5 concludes this report with key findings from each study component.

Acknowledgements

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Chapter 1. Quantitative Findings

In this chapter, we present results from our quantitative analysis of dual-credit programs in Texas. We designed our quantitative analysis to address three of the primary RQs from the larger study. Specifically, we addressed the following questions:

RQ 1 What factors contribute to racial/ethnic disparities in dual-credit participation?

RQ 2 What changes in dual-credit participation, success, and delivery have occurred since the passage of HB 505?

RQ 3 To what extent does dual-credit participation increase college enrollment, degree attainment, and efficient degree completion?

Questions 1 and 2 are descriptive in nature, while question 3 requires the use of state-of-the-art econometric methods to assess the causal impact of dual-credit participation on student outcomes.

Background and Policy Context

Dual-credit education has been held as a policy option that could improve college participation and completion and is expanding rapidly nationwide. Advocates of dual-credit programs argue that it can help students adjust to college expectations, provide academically challenging courses, help to align curriculum across high school and colleges, and may help lower costs to students and reduce overall time to earning a degree. Although public sentiment regarding dual-credit is positive, it is not without critics. Specific criticisms include concerns over the rigor of dual-credit courses relative to college credit-only courses, difficulties surrounding the transfer of dual-credit courses once students enroll after high school, as well as concerns that limited access and quality of dual-credit courses for disadvantaged students could exacerbate already large inequities in college enrollment and completion.

A large and growing body of national research on the impact of dual-credit education sheds light on some of these issues, but significant gaps remain. Indeed, a recent Intervention Report from the U.S. Department of Education's What Works Clearinghouse (WWC) concluded that the national research on dual-credit education has been largely positive but is lacking in many ways (U.S. Department of Education, 2017). The vast majority of the 35 studies of dual-credit considered by the WWC for the Intervention Report found that dual-credit education programs are related to positive student outcomes. However, most studies of general dual-credit education were descriptive in nature, with just three studies (An, 2013; Giani, Alexander, & Reyes; 2014; Struhl & Vargas, 2012) employing quasi-experimental methods that met WWC

standards "with reservations." Although two experimental studies of ECHSs (Berger, Tuck-Bicacki, Garet, Knudson, & Hoshen, 2014; Edmunds et al., 2015) met WWC "without reservations" and found positive impacts on high school completion and college enrollment, it is unclear how those results translate to dual-credit education generally—where models of advising and instruction are less prescribed. Moreover, nearly all studies of dual-credit education and ECHS focused overwhelming on short-term outcomes like high school completion and college enrollment, so lawmakers know very little about the extent to which dual-credit programs improve college completion or the degree to which it reduces credits or time to degree, particularly for students who are traditionally less likely to pursue a postsecondary credential after high school.

Our causal impact study addresses several gaps in the research base. In particular, it is one of the first studies to use methods designed to isolate the causal impact of general dual-credit programs at scale short- and long-term student outcome, and is one of the first to examine the impact of dual-credit participation on time and semester credit hours (SCH) to degree.

Organization of Chapter

We begin by describing the data we used to address each of the three RQs. Next, we describe the general approach to the descriptive analyses we used to address questions 1 and 2 and present results related to each of those questions. Next, we describe our econometric approach to addressing question 3 and go on to present relevant findings from the causal impact study. We end the chapter by summarizing the key findings from the quantitative analyses.

Data

Our analyses draw on administrative databases from THECB and TEA that allow us to track Texas public high school students through high school and into any public college or university in Texas.[2] For FY 2000–17, we can use these files to capture individual-level information on student demographics and student participation in dual credit in high school, including the number of SCH earned in high school as dual-credit. During these years, we are also able to capture information on enrollment SCH earned and degree completion at any public or private college in Texas. For all college-level courses completed in 2012–17, which include those delivered for dual-credit, we can also capture more detailed course-level information, including information about the course modality (face-to-face, online, or hybrid), faculty characteristics

[2] As described in the Appendix A, some analyses also track students into any private colleges in Texas, while others also track students into out-of-state colleges. We only have this data for some cohorts and outcomes, so not all analyses track students to these colleges.

(tenured, adjunct, and whether the instructor of record was also employed as a high school teacher), and location of delivery (on a college campus, on a high school campus, or at an ECHS). We also draw on data from the National Student Clearinghouse, which allows us to capture enrollment and degree completion during Academic Year (AY) 2008-17.

We use the files above to develop two analytic data files that we draw upon for various analyses. Our primary analytic data file that we use for questions 1 and 3 tracks the 2001–16 cohorts of juniors at Texas public high schools through high school and into Texas colleges and universities, capturing information on demographics, dual-credit participation, college enrollment and completion, and SCH and time to degree. Because HB 505 was not passed until 2015, we use a different analytic file to address question 2. Specifically, we observe dual-credit participation and success for all then-current Texas public high school students from 2012–17. Since HB 505 was passed in 2015, this allows us to capture two years of post-HB 505 data on dual-credit participation and success, specifically from the 2016–17 academic years.

We define a student being enrolled in an ECHS if the high school they attend is an ECHS or if it shares a campus with an ECHS. Prior to 2015, we cannot directly see if a student attending a high school that shares a campus with an ECHS is enrolled in dual-credit through the ECHS or through the traditional high school. As such, we treat all students on a campus with an ECHS as attending an ECHS. For questions 1–2, we omit students attending an ECHS from the analysis. For descriptive analyses in question 3 that examine the prevalence of ECHS relative to other forms of dual-credit, our estimates can be taken as an upper bound.

We describe the individual administrative data files that we draw on and the approach we used to link them to develop our analytic data files in Appendix A.

Approach to Questions 1 and 2

We use our two analytic data files to paint a rich descriptive picture of patterns in dual-credit participation, delivery and course taking in Texas over time, and we primarily rely on simple descriptive statistics presented in intuitive figures and tables to achieve this. However, where appropriate, we employ regression methods to make more nuanced comparisons. Throughout this section, unless otherwise noted, all reported differences in relevant variables are statistically significant at conventional levels (95%).

Racial Disparities

Findings Related to Question 1: What Factors Contribute to Disparities in Dual-Credit Participation?

In Phase I of the dual-credit study, RAND found disparities in dual-credit participation across race/ethnicity and income. Figure 1.1 that follows is taken from RAND's Interim Report and shows dual-credit participation rates by race/ethnicity for the 2001–15 cohorts of Texas public high school graduates. The results demonstrated that Whites and Asians had higher participation rates than Blacks and Hispanics throughout the study period. Dual-credit participation rates of White high school graduates peaked at about 30% in 2011 and declined to 26% in 2015. Dual-credit participation rates of Blacks peaked at about 13% in 2009 and declined to approximately 10% by 2015. Similarly, dual-credit participation rates of Hispanics peaked at about 20% in 2011 and declined to approximately 16% by 2015.

Figure 1.1. Dual-Credit Participation Rates by Race/Ethnicity (2001–15)

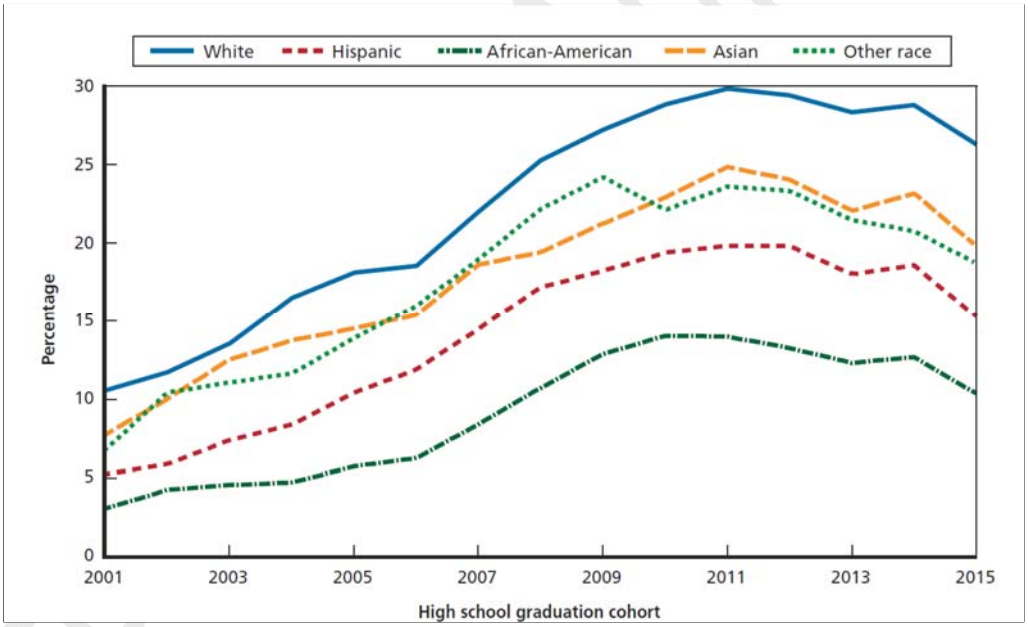
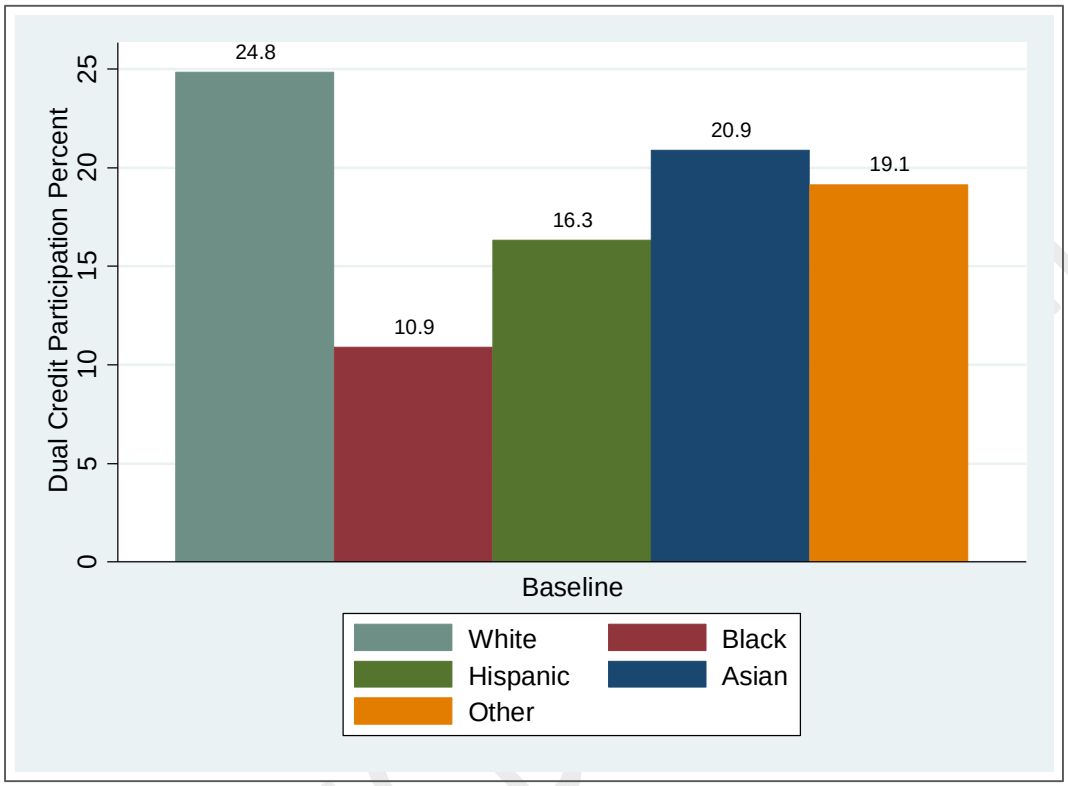


Figure 1.2 reports the dual-credit participation rate by race/ethnicity for the 2001–16 cohorts of Texas high school juniors using our updated data and confirms gaps in dual-credit participation by race/ethnicity. Specifically, while 24.8% of White Texas public high school juniors took a dual-credit course during their junior or senior year of high school, the corresponding figure for Blacks and Hispanics was 10.9% and 16.3%, respectively.

Figure 1.2. Dual-Credit Participation by Race/Ethnicity (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)



While Phase I documented the persistent disparities in dual-credit participation, it was only able to hypothesize about potential reasons underlying their existence. In this section, we use descriptive analyses to assess the extent, if any, to which different factors underlying gaps in dual-credit participation across race/ethnicity. Our analysis focuses on the following potential factors: (1) differences in dual-credit access across high schools in Texas, (2) differences in academic preparation, (3) differences in income, (4) differences in access to alternative forms of college-level coursework in high school, such as AP and IB courses, (5) differences in access to tuition and fee waivers for dual-credit students across high schools, and (6) differences in the types of high schools they attend. We also investigate in Chapter 2 whether dual-credit advising practices may contribute to disparities in dual-credit participation by race/ethnicity.

To assess the extent to which different factors contributed to the gaps shown in Figure 1.2, we began by running a series of Ordinary Least Squares (OLS) regression models predicting the probability of dual-credit participation as a function of a student's race/ethnicity, holding each factor considered constant. We then use the results of these regression models to replicate the analysis used to create Figure 1.2, holding the factor constant at the mean value for White

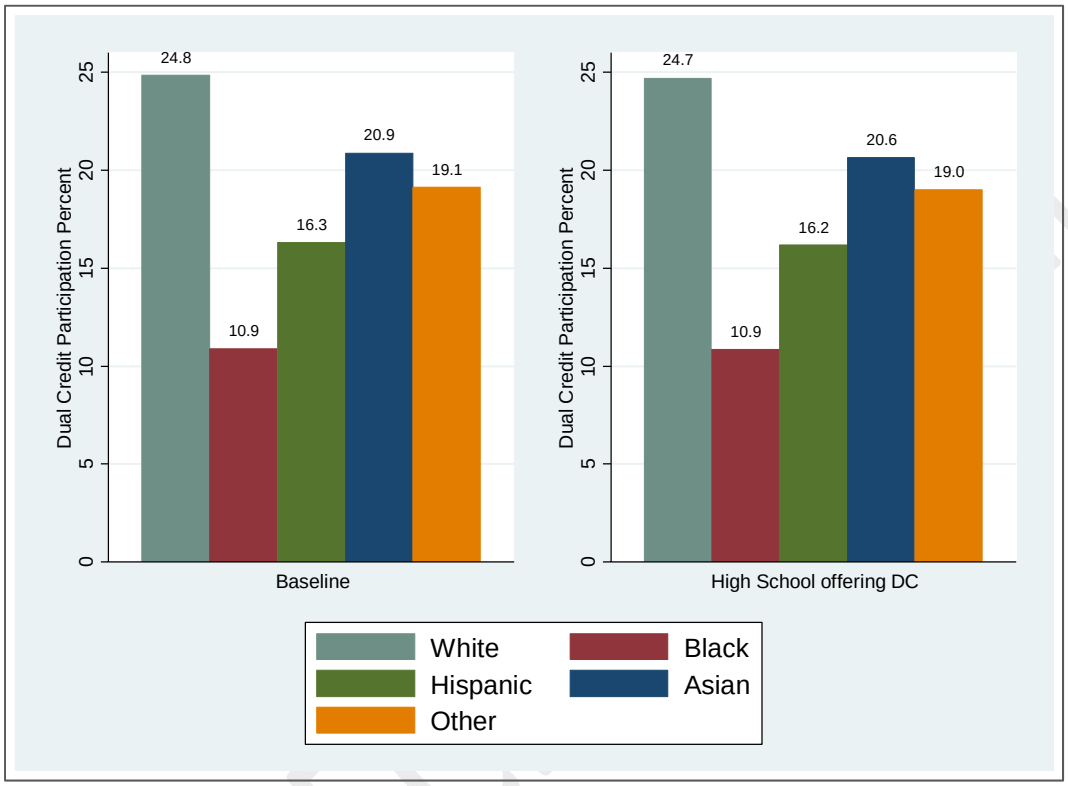
students across race and ethnic groups. We describe these models and the process used to develop the adjusted figures in greater detail in Appendix A.

Differences in Dual-Credit Access Explains Very Little of the Gap in Dual-Credit Participation Across Race/Ethnicity

One factor that could partially explain gaps in dual-credit participation across race/ethnicity is differential access to dual-credit courses. Our analysis shows that during the 2015–16 academic year, 93% of high schools in Texas offered at least one dual-credit course.[3] Although the rate is high statewide, it is possible that underrepresented minorities are more concentrated in schools without dual-credit programs, which would contribute to the gap in dual-credit participation across race/ethnicity. To explore this hypothesis, the rightmost set of columns in Figure 1.3 shows the predicted difference in dual-credit participation across race and ethnic groups in Texas when holding differences in dual-credit access constant across race and ethnic groups. Here, we say a student has dual-credit access if, during his/her junior year, s/he attended a high school that offered at least one dual-credit course. The leftmost set of columns in Figure 1.3 show the raw unadjusted difference in dual-credit participation by race/ethnicity that are reported in Figure 1.2. The fact that the adjusted and unadjusted dual-credit participation rates are nearly identical suggests that differences in dual-credit access across race/ethnicity explains very little of the observed gaps in dual-credit participation across those groups.

[3] The majority of high schools that did not offer dual-credit courses were non-traditional schools such as alternative, charter, or disciplinary schools.

Figure 1.3. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in Dual-Credit Access (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)

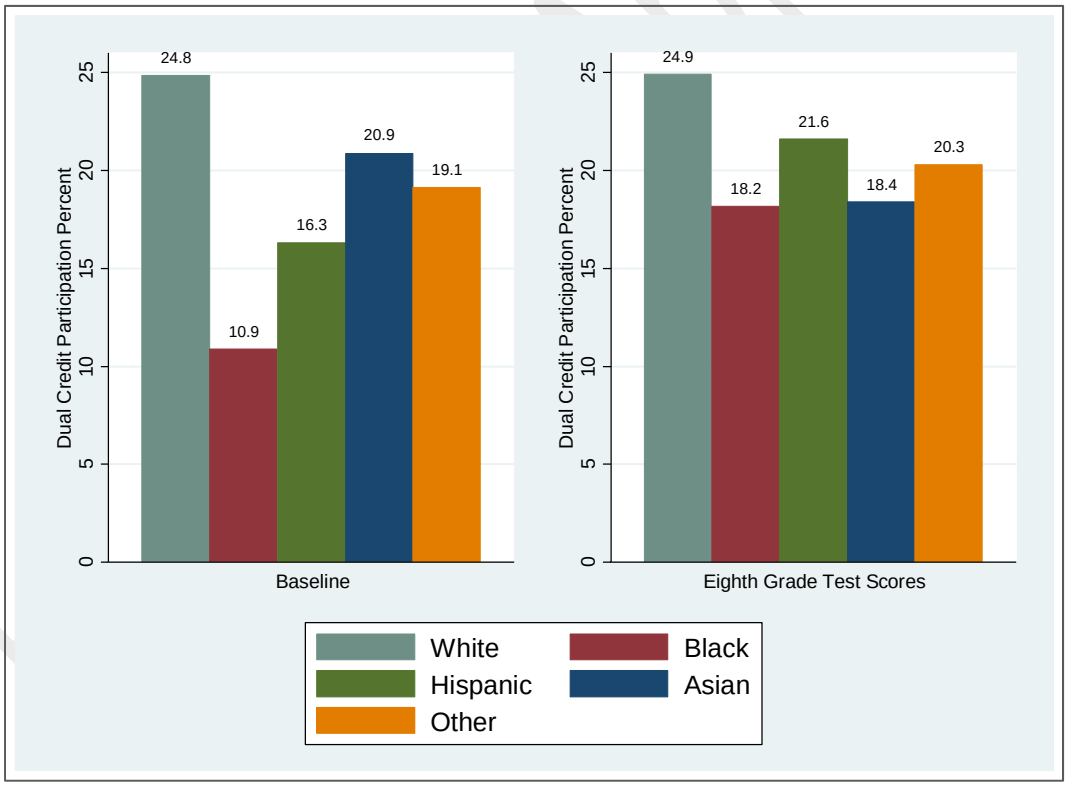


Differences in Academic Preparation Explain Some, But Not All, of the Gap in Dual-Credit Participation Across Race/Ethnicity

Another factor that could partially explain differences in dual-credit participation across race/ethnicity is differences in academic preparation. Dual-credit participation is limited to students who are academically prepared to take dual-credit courses, and eligible students with lower levels of baseline preparation may be less likely to participate in dual credit due to the difficulty of the course or lower desire to enroll in college after high school. Because we know that underrepresented minorities tend to have lower achievement test scores compared with Whites on average, this factor is likely to contribute to the observed differences in dual-credit participation across race/ethnicity. To examine this, the rightmost columns of Figure 1.4 shows the predicted difference in dual-credit participation across race and ethnic groups in Texas when holding differences in academic preparation constant across race and ethnic groups. We proxy for academic preparation in a student's junior year by controlling for his/her score on that state mathematics and reading achievement tests, the Texas Assessment of Academic

Skills (TAAS), Texas Assessment of Knowledge and Skills (TAKS), or State of Texas Assessments of Academic Readiness (STAAR) exams, in the eighth grade. The results suggest that differences in academic preparation across race/ethnicity contribute significantly to the observed gaps in dual-credit participation. For example, if Hispanic students had the same eighth grade mathematics and reading scores as the typical White student, then their dual-credit participation rate would increase from 16.3% to 21.6%. Similarly, if Black students had the same eighth-grade mathematics and reading scores as the typical White student, then their dual-credit participation rate would increase from 10.9% to 18.2%. The adjusted participation rates for underrepresented minorities are still below the dual-credit participation rate of 24.8% for White students, suggesting that differences in academic preparation do not fully explain the dual-credit participation gap.

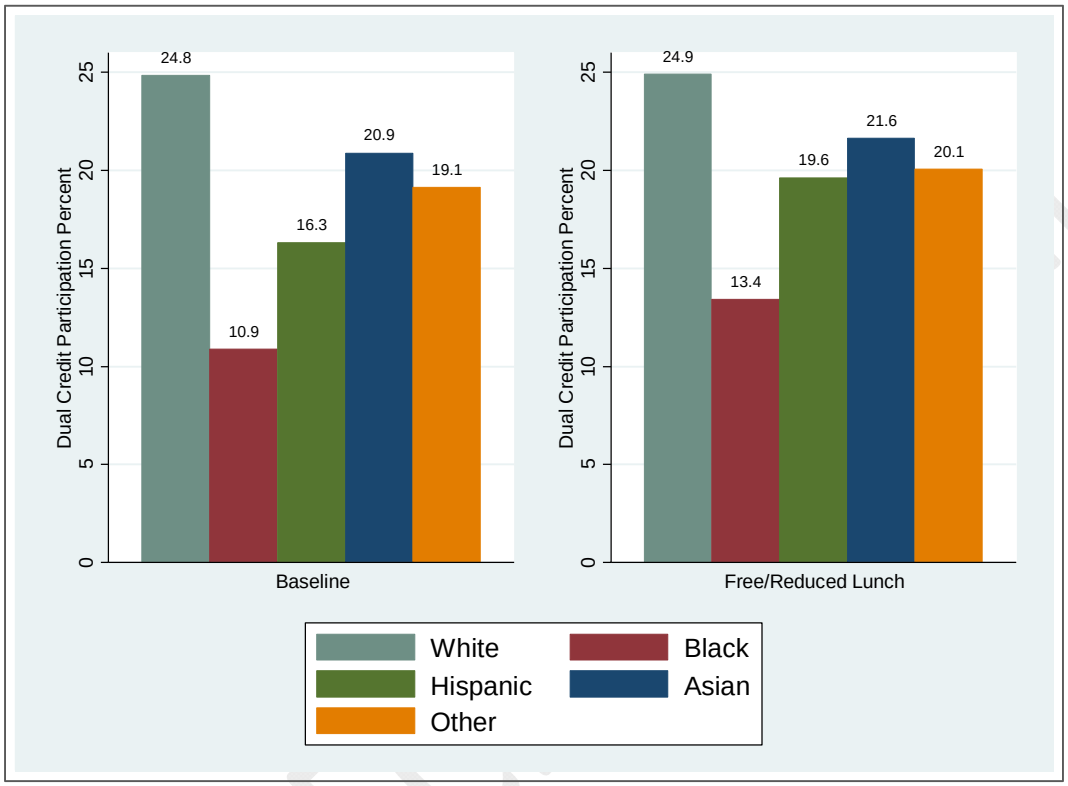
Figure 1.4. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in Eighth-Grade Achievement Test Scores (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)



Differences in Income Explain Some, But Not All, of the Gap in Dual-Credit Participation Across Race/Ethnicity

Another factor that could partially explain differences in dual-credit participation across race/ethnicity is differences in income. In many cases, dual-credit participants must contribute to tuition and fees or purchase books and other course materials for dual-credit courses. In other cases, students may need transportation to attend dual-credit courses on college campus. Because we know that underrepresented minorities tend to have lower income compared with Whites on average, this factor is likely to contribute to the observed differences in dual-credit participation across race/ethnicity. To explore this factor, Figure 1.5 shows the predicted difference in dual-credit participation across race and ethnic groups in Texas when holding differences in income (measured by free or reduced-price lunch eligibility) constant across race and ethnic groups at the mean value for White students. The results suggest that differences in income across race/ethnicity contribute significantly to the observed gaps in dual-credit participation. For example, if Hispanic students had the same rate of free or reduced-price lunch eligibility as the typical White student, then their dual-credit participation rate would increase from 16.3% to 19.6%. Similarly, if Black students had the same rate of free or reduced-price eligibility as the typical White student, then their dual-credit participation rate would increase from 10.9% to 13.4%. The adjusted participation rates for underrepresented minorities are still well below the dual-credit participation rate of 24.8% for White students, suggesting that differences in income do not fully explain the dual-credit participation gap.

Figure 1.5. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in Free or Reduced-Price Lunch Eligibility (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)

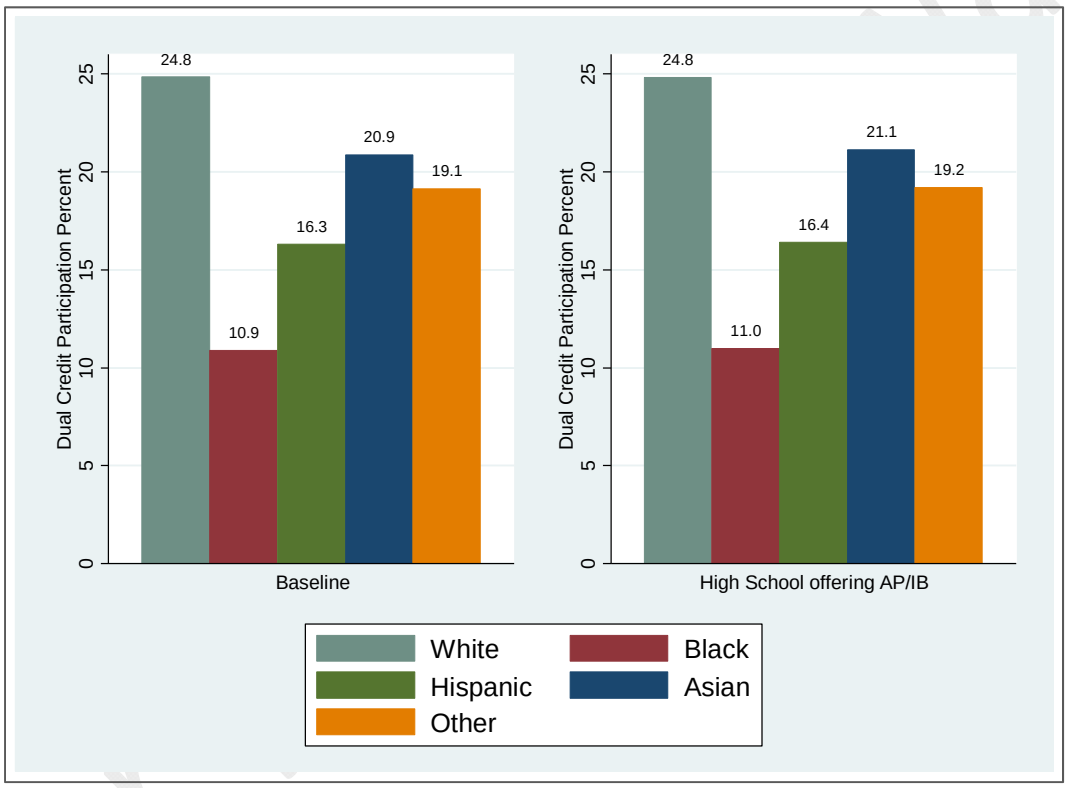


Differences in Access to AP or IB Coursework Explains Very Little of the Gap in Dual-Credit Participation Across Race/Ethnicity

Another factor that could partially explain gaps in dual-credit participation across race/ethnicity is differential access to other forms of advanced coursework like AP and IB courses. When such courses are present, students may opt to take them in lieu of dual-credit courses. Not all high schools in Texas offer AP or IB courses to their students. Indeed, our analysis shows that during the 2015–16 academic year, 94% of high school juniors in Texas attended a high school that offered at least one AP or IB course. If White students are more likely than underrepresented minorities to attend high schools that offer AP or IB courses, this might explain part of the gap in dual-credit participation across race/ethnicity. The rightmost set of columns in Figure 1.6 below shows the predicted difference in dual-credit participation across race and ethnic groups in Texas when holding differences in access to AP and IB courses constant across race and ethnic groups. As with previous figures, the leftmost set of columns replicates the baseline dual-credit participation rates from Figure 1.2. Here, we say a student has access to AP or IB

courses if, during his/her junior year, s/he attended a high school that offered at least one AP or IB course. The fact that adjusted participation rates in the rightmost columns of Figure 1.6 are nearly identical to the baseline dual-credit participation rates in the leftmost columns suggests that differences in access to AP and IB courses across race/ethnicity explains very little of the observed gaps in dual-credit participation across those groups.

Figure 1.6. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in Access to AP and IB Courses (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)



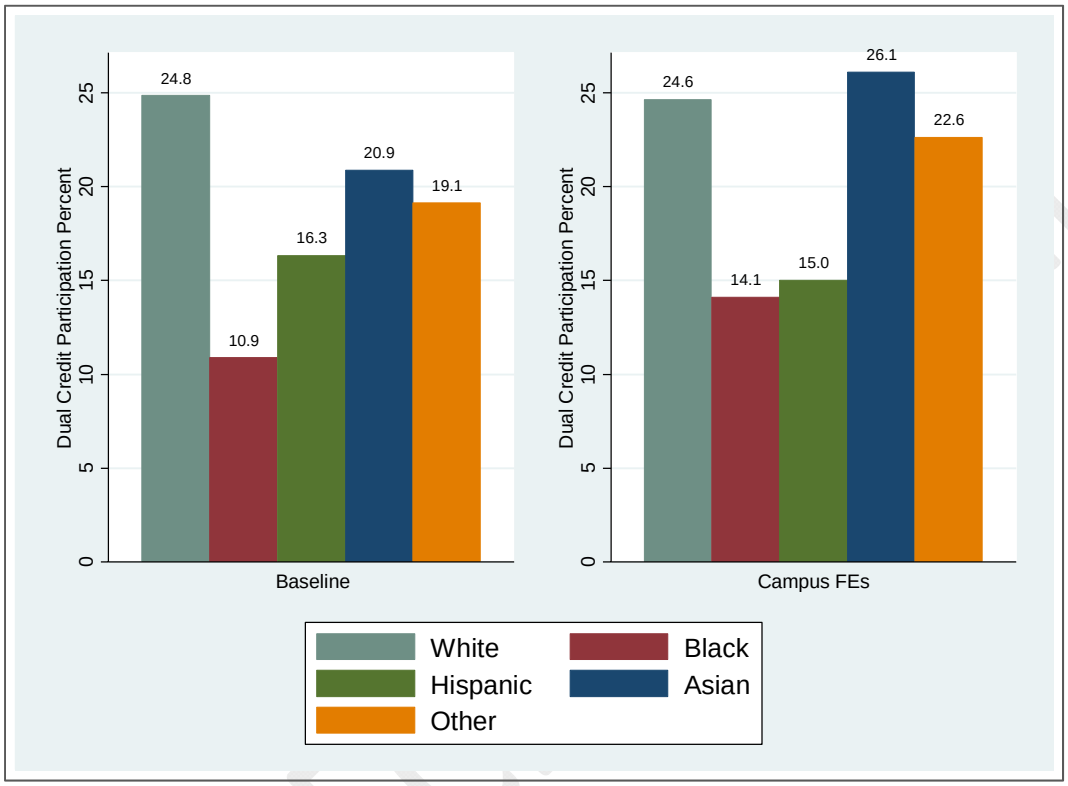
Differences in High Schools Attended by Students of Different Race/Ethnic Groups Explains Some, But Not All, of the Gap in Dual-Credit Participation

Another factor that could explain some of the gap in dual-credit participation across race/ethnic groups is differences in the high schools attended across race/ethnicity. White student are more likely to attend better resourced schools in more affluent areas. Attendance at such schools may promote dual-credit participation by better preparing students for dual-credit coursework, by more actively promoting dual-credit programs to students, or by exposing students to more peers with college aspirations. To explore this factor, Figure 1.7 shows the

predicted difference in dual-credit participation across race and ethnic groups in Texas when holding high school attendance patterns constant across race and ethnic groups at the mean value for White students.[4] The results suggest that differences in high school factors across race/ethnicity contribute significantly to the observed gaps in dual-credit participation for Black students, but not much for Hispanic students. For example, if Black students attended the same high schools in equal rates as White students, then their dual-credit participation rate would increase from 10.9% to 14.1%. Although the results suggest that if Hispanic students attended the same high schools in equal rate as White students, then their dual-credit participation rate would decrease slightly from 16.3% to 15.0%, this difference is not statistically significant. In either case, the adjusted participation rates for underrepresented minorities are still well below the dual-credit participation rate of 24.8% for White students, suggesting that differences in where students go to high school do not fully explain the dual-credit participation gap.

[4] To do so, we run an OLS model predicting dual credit participation by race/ethnicity and including a high school fixed effect. We then project the dual credit participation rate for each race/ethnic group for a student with a weighted average of the high school fixed effects, where the weight for a given high school is the share of White students at the high school divided by the total number of White students in the state.

Figure 1.7. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in Where Students Attended High School (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)

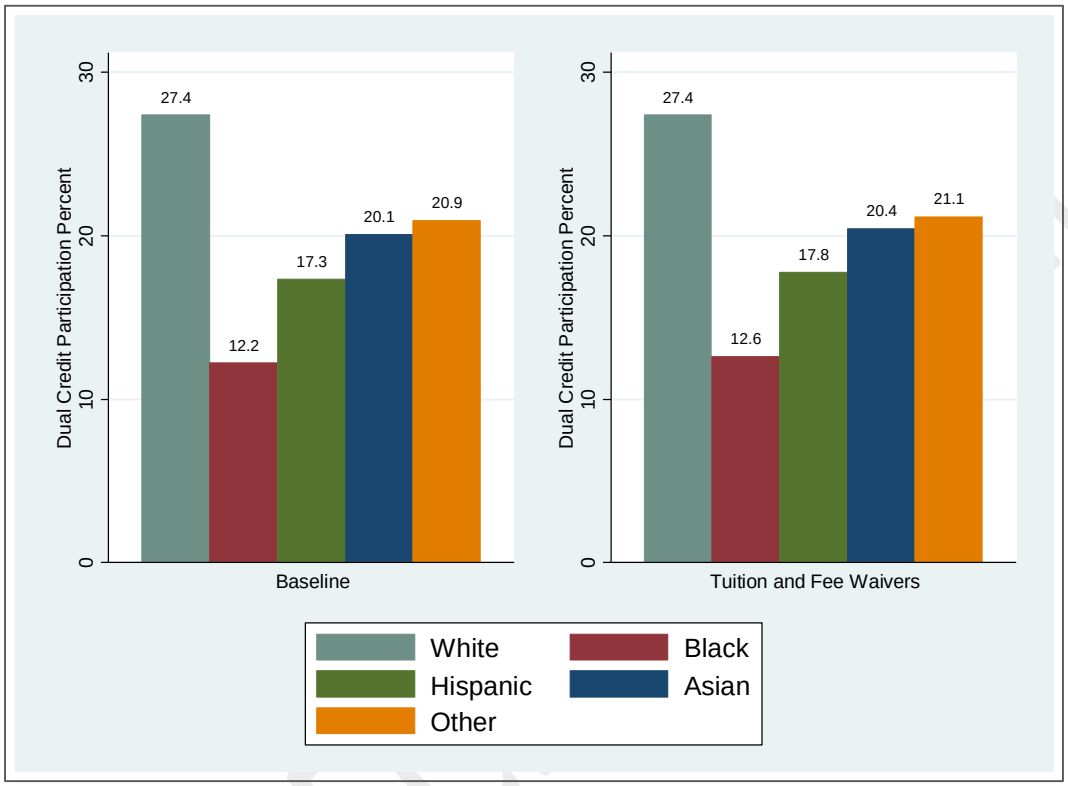


Differences in Access to Tuition and Fee Waivers Across High Schools Within Texas Explains Very Little of the Gap in Dual-Credit Participation Across Race/Ethnicity

Another factor that could explain some of the gap in dual-credit participation across race/ethnicity is access to tuition and fee waivers for dual-credit courses. As described later in Chapter 4, policies governing the charging of tuition and fees for dual-credit students varies considerably across dual-credit programs. Many community colleges do not charge tuition to any of their dual-credit students, some charge the same tuition for a dual-credit course as they would for a college credit only course, and still others charge some tuition but a lower rate than is charged for the equivalent college credit-only course. In some cases, community colleges offer tuition and fee waivers or discounted tuition to some dual-credit students but not others. If White students are more likely to attend high schools with community college partners that offer tuition and fee waivers than are underrepresented minorities, this could explain some of the gap in dual-credit participation across race/ethnicity. To explore this factor, we obtained data from the Texas Association of Community Colleges on tuition and fee waiver policies for

the 2016–17 academic year at all community colleges in Texas. The data provide information on whether each community college provided a full or partial tuition and fee waiver to all or some of the students taking dual-credit courses at their institution. The rightmost set of columns in Figure 1.8 below shows the predicted difference in dual-credit participation across race and ethnic groups in Texas when holding differences in access to tuition and fee waivers constant across race and ethnic groups. Figure 1.8 was only calculated using AY 2015–16 junior students, and the baseline figure was replicated with the changing sample. Here, we say a student has access to a tuition/fee waiver if, during his/her junior year, s/he attended a high school that that partnered with a community college that offered a full or partial tuition and fee waiver to all of its students. Although the adjusted participation rates for underrepresented minorities in the rightmost columns of Figure 1.8 are slightly higher than the corresponding unadjusted rates in the leftmost columns, the difference is never statistically significant. This suggests that differences in access to tuition and fee waivers across high schools in Texas explains little of the gap in dual-credit participation by race/ethnicity. It is important to note that this does not mean that tuition and fees are not a barrier to dual-credit participation for underrepresented or low-income students. In particular, our analysis only examines whether differences in access to tuition and fee waivers across race/ethnicity explain gaps in dual-credit participation; it does not examine whether tuition and fee waivers improve dual-credit participation rates overall or for underrepresented minorities or low income students.

Figure 1.8. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in Dual-Credit Tuition and Fee Waivers (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2016; *n* = 311,383)

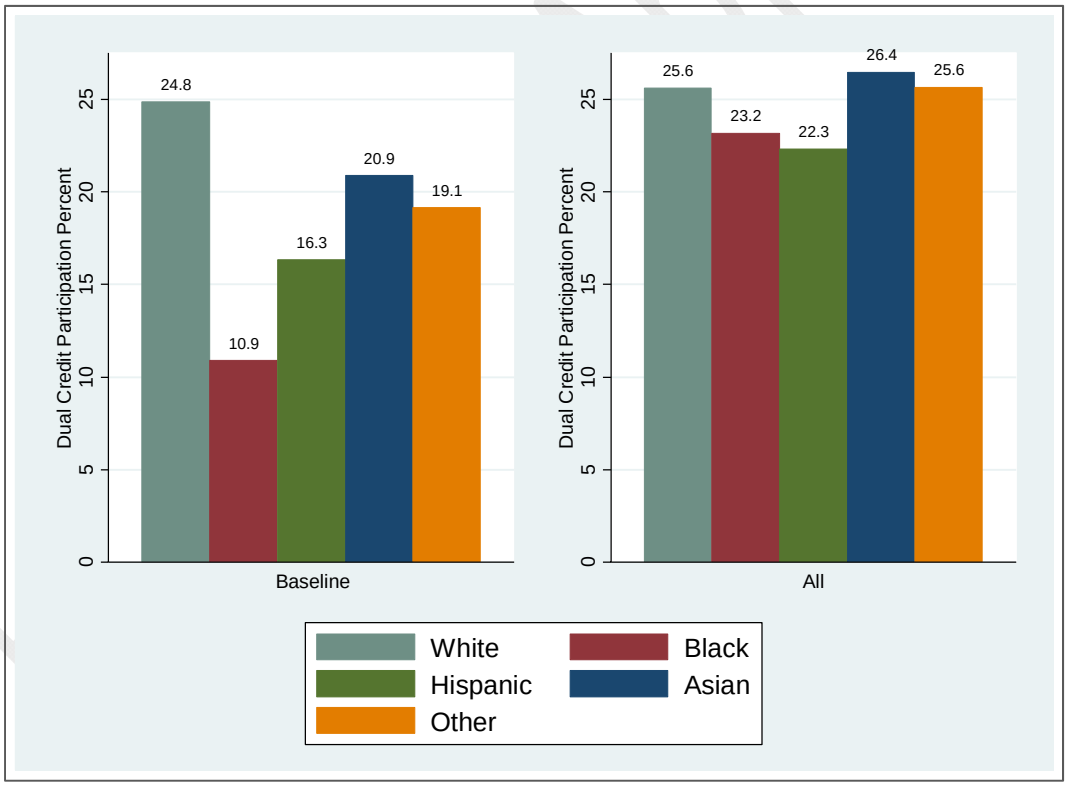


Combined, the Six Observable Factors Considered Explain Most, But Not All, of Gap in Dual-Credit Participation Across Race/Ethnicity

The previous analysis has shown that differences in academic preparation, income, and high school attendance patterns each explain some, but not all, of the gap in dual-credit participation across race/ethnicity. At the same time, differences in access to dual-credit and AP and IB courses and tuition and fee waivers do not appear to explain much of this gap. The analysis so far has examined each of these factors on its own. To take the analysis a step further, we used a similar approach to assess the extent to which all of these factors combined contribute to gaps in dual-credit participation. To do so, we ran a regression model predicting the probability of dual-credit participation as a function of a student's race/ethnicity, holding all of these observable factors considered constant, and then used the results to project the dual-credit participation rate by race/ethnicity holding all factors constant at the median value for

White students.[5] Figure 1.9 displays these results graphically and demonstrate that the factors we considered explain most, but not all, of the dual-credit participation gap. For example, if Hispanic students had the same value for all factors as the typical White student, then their dual-credit participation rate would increase from 16.3% to 22.3%. Similarly, if Black students had the same value for all factors as the typical White student, then their dual-credit participation rate would increase from 10.9% to 23.2%. The adjusted participation rates for Black and Hispanic students are only slightly lower than the White participation rate of 24.8%, suggesting that the factors explain most of the overall gap in dual-credit participation. Overall, this suggests that if underrepresented minorities were equally prepared academically. had similar incomes to and attended similar schools as White students, then gaps in DC participation would be quite small.

Figure 1.9. Dual-Credit Participation by Race/Ethnicity, Adjusting for Differences in All Factors Considered Previously (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,422,095)



[5] Note that to implement this approach for all cohorts, we could not include access to tuition and fee waivers in the model. This is because we had data on tuition and fee waivers only for the 2016–17 academic year.

One additional factor that could contribute to differences in dual-credit participation across race/ethnicity is differences in advising practices. If high school and college staff who advise students for dual-credit courses exhibit explicit or implicit biases that disadvantage underrepresented minorities, this could contribute to gaps in dual-credit participation. We were unable to explore this factor quantitatively but assess it qualitatively in Chapter 2 and find little evidence to support the existence of biases in advising practices.

HB 505 Study

What Changes in Dual-Credit Participation, Success, and Delivery Have Occurred Since the Passage of HB 505?

In 2015, the 84th Texas Legislature passed HB 505, which loosened prior restrictions on dual-credit access in a number of ways. Specifically, HB 505 did the following:

1. Removed limitations on the number of dual-credit courses a student may take during high school
2. Removed limitations on the number of dual-credit courses a student may take each academic year
3. Allowed ninth and 10th grade students to enroll in dual-credit coursework that is not delivered in an ECHS

Phase I did not examine trends in dual-credit participation, success, and delivery since the passage of HB 505. In this section, we address that gap by using THECB and TEA data[6] to descriptively examining changes in student participation and outcomes, as well as changes in how institutions are delivering dual-credit education to high school students.

Note that data examining trends in student participation and outcomes, and in the delivery of dual-credit education prior to the passage of HB 505 include the 2012–15 fiscal years; data examining these same trends after the passage of HB 505 include the 2016–17 fiscal years.

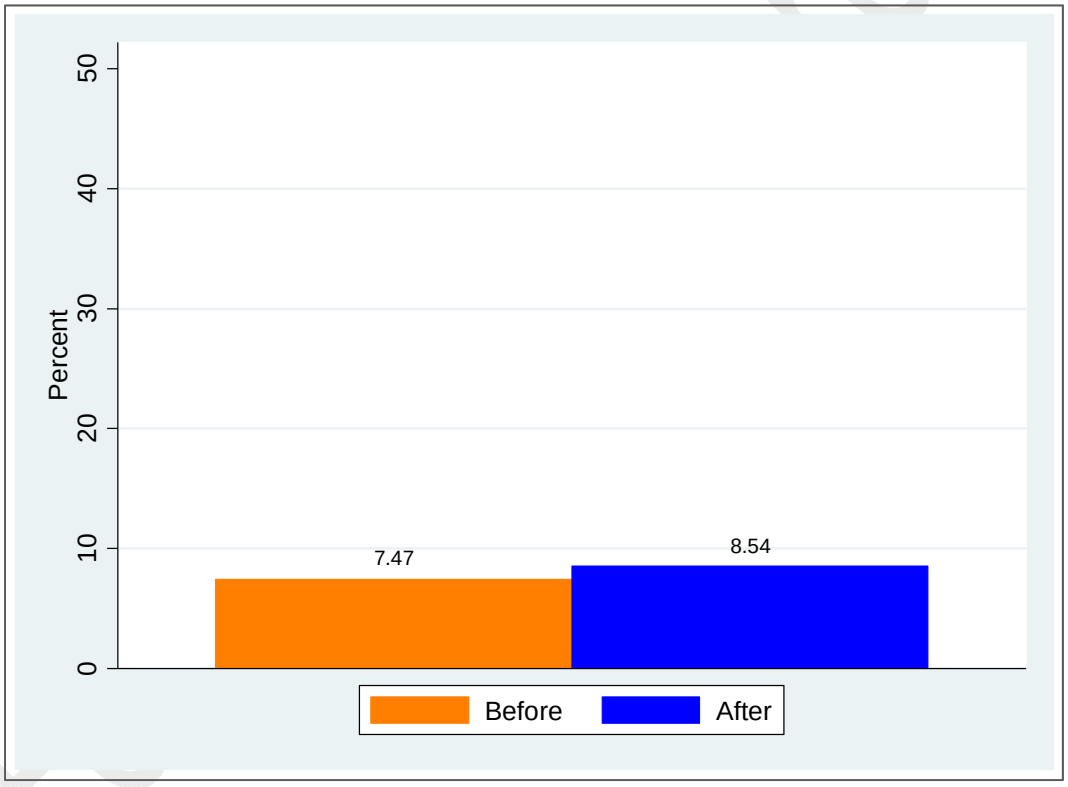
[6] As described in Appendix A, given how recently HB 505 was passed, we use an analytic file that observed dual credit participation and success for all Texas public high school students from 2012–17. This allowed us to capture trends in dual credit participation by grade for the 2012–17 academic years.

Changes in Dual-Credit Participation Since HB 505

Overall Dual-Credit Participation Rate Held Relatively Steady Since HB 505

Given that HB 505 loosened restrictions on dual-credit participation in a number of ways, we were interested in whether dual-credit participation had increased since the bill's passage. Figure 1.10 shows trends in the overall dual-credit participation rate from 2012–17 and demonstrates that dual-credit participation held relatively flat over that time frame. The participation rate among all ninth to 12th grade students was 7.5% prior to the passage of HB 505 from 2012–15, and increased slightly to 8.5% from 2016–17.

Figure 1.10. Dual-Credit Participation Rate Among All Texas Public High School Students (2012–17; *n* = 8,580,735)

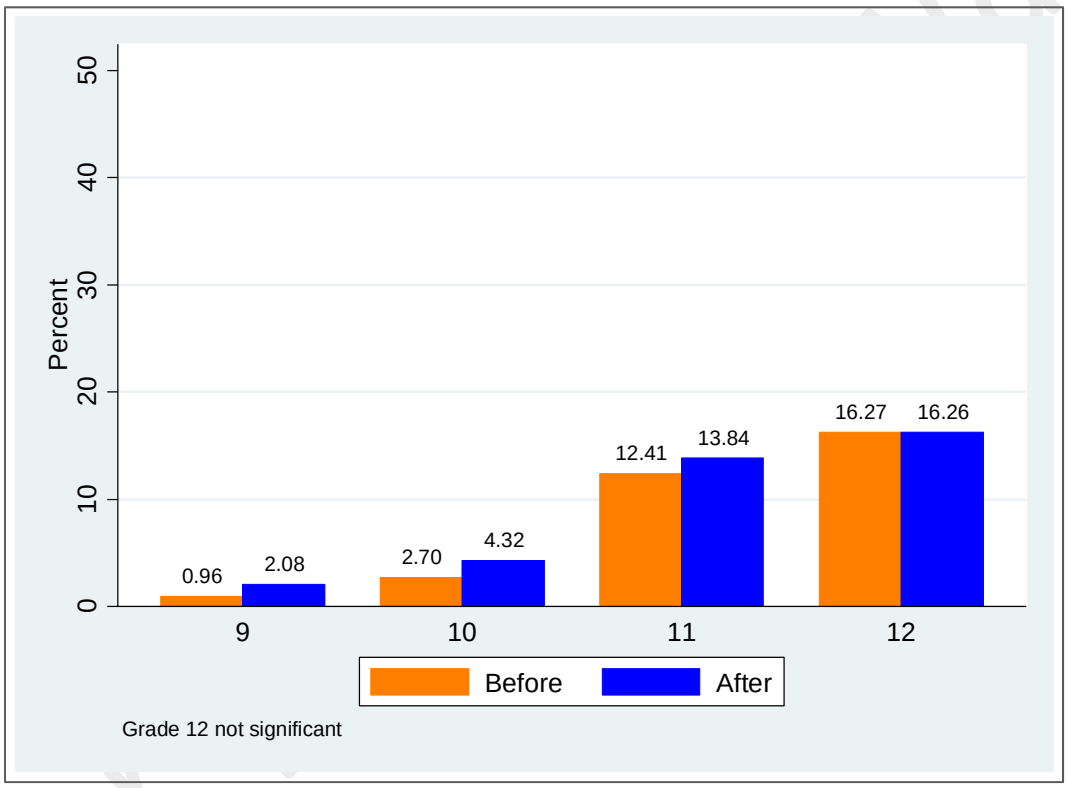


Dual-Credit Participation Among Ninth and 10th Graders Increased But Is Still Low Overall

Since HB 505 specifically loosened restrictions on dual-credit participation among ninth and 10th graders, we also assessed trends in dual-credit participation rates by grade from 2012–17. These trends are presented in Figure 1.11 and demonstrate that dual-credit participation held relatively

flat over that time frame for 11th and 12th graders, who make up the vast majority of dual-credit participants. Specifically, from 2012–17, the participation rate among 11th graders hovered around 13% and around 16% for 12th graders. In contrast, while the participation rate among ninth and 10th graders was low before and after the passage of HB 505, the rate more than doubled from 1.0% to 2.1% among ninth graders (from 4,479 to 7,721 students annually) and increased by 60% from 2.7% to 4.3% among 10th graders (from 8,445 to 19,192 students annually).

Figure 1.11. Dual-Credit Participation Among Texas Public High School Students by Grade (2012–17; *n* = 8,580,735)

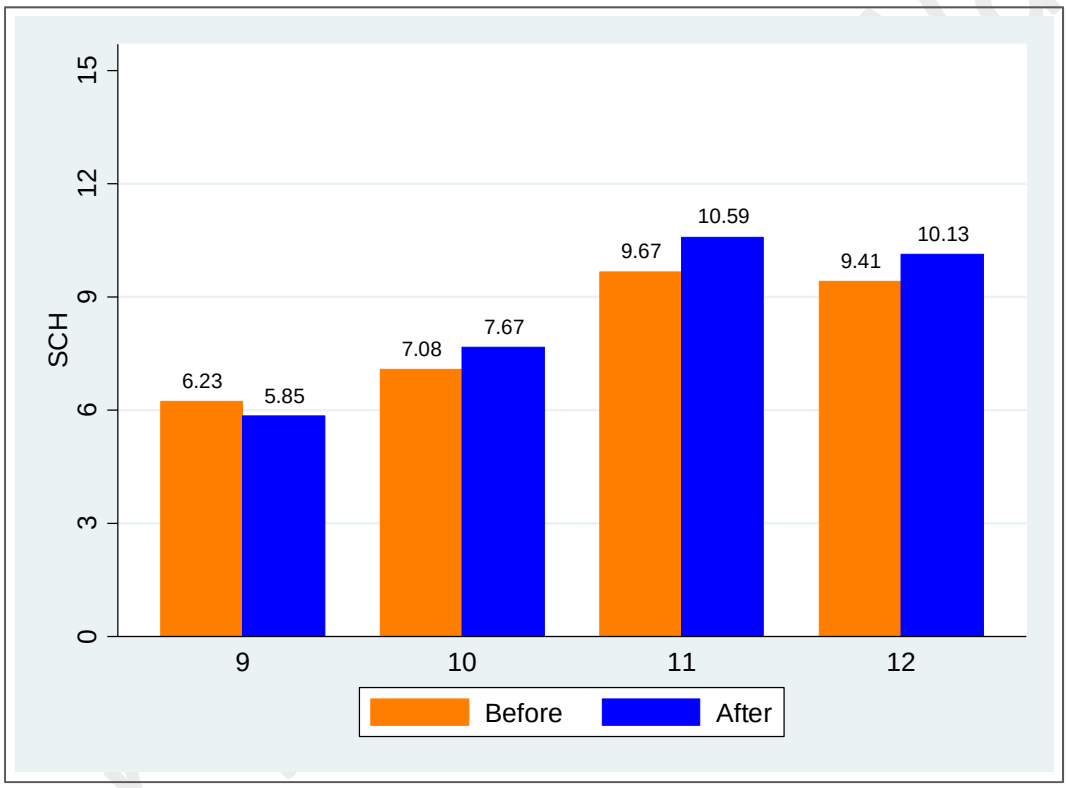


Semester Credit Hours of Dual Credit Taken Among Dual-Credit Participants Increased Since HB 505

HB 505 also loosened restrictions on the number of dual-credit courses a student could take each academic year and overall during high school, so we were interested in whether the number of SCH of dual credit taken among dual-credit participants increased after the passage of HB 505. Figure 1.12 presents trends in the number of SCH of dual credit taken among dual-credit participants by grade before and after HB 505. The results demonstrate that the number of SCH of dual credit taken by dual-credit participants increased among 10th–12th graders, but

declined slightly among ninth graders after HB 505. Overall, the number of SCH of dual credits taken by dual-credit participants was highest among 11th and 12th participants who took an average of 9.7 and 9.4 SCH of dual credit prior to HB 505 versus 10.6 and 10.1 SCH after HB 505. Although the overall dual-credit participation rate was low among ninth and 10th graders, the number of SCH of dual-credit taken by participants in those grades was roughly equivalent to two 3-SCH courses (6.2 and 7.1 SCH before HB 505 versus 5.9 and 7.7 SCH afterward).

Figure 1.12. SCH of Dual Credit Taken Among Dual-Credit Participants by Grade (2012–17; *n* = 673,151)



Changes in Dual-Credit Context Since HB 505

Dual-Credit Course Offerings Similar Since HB 505 and Are Concentrated Within the Academic Core

Table 1.1 presents the 10 most common dual-credit courses before and after the passage of HB 505. The most common dual-credit courses include English, government, history, economics, and mathematics and have remained relatively unchanged since the passage of HB 505. This suggests that while HB 505 loosened restrictions around the number of dual-credit courses that students can take, postsecondary institutions and partner high schools may be nevertheless

implementing policies that restrict the types of dual-credit courses that students can take. This finding is consistent with qualitative evidence on advising practices that is presented in Chapter 2. In addition, it is consistent with the fact that the state restricts the actual courses that can be offered and/or funded for dual credit.

Table 1.1. Most Common Dual-Credit Courses for All Students (2012–17)

Before HB 505		After HB 505	
Course	**Percent of all DC SCH represented by course**	**Course**	**Percent of all DC SCH represented by course**
ENGL 1301	10.69%	ENGL 1301	9.67%
ENGL 1302	10.00%	ENGL 1302	8.59%
HIST 1302	7.30%	HIST 1302	6.47%
HIST 1301	6.79%	GOVT 2305	6.25%
GOVT 2305	5.74%	HIST 1301	6.24%
ECON 2301	4.30%	ECON 2301	3.77%
MATH 1314/1414	3.57%	MATH 1314/1414	3.48%
PSYC 2301	1.90%	PSYC 2301	2.09%
ENGL 2322	1.71%	ENGL 2322	1.88%
ENGL 2323	1.42%	GOVT 2306	1.73%

Learning Frameworks Most Common Course Taken by Ninth- and 10th-Grade Dual Credit Students

We also examined the most common dual-credit courses before and after HB 505 by grade. These results are presented in Table 1.2 and show little differences in common dual-credit courses over time across grades. However, more interestingly, Table 1.2 also demonstrates that while 11th and 12th graders mostly take courses within the academic core, the most common course taken by ninth- and 10th-grade dual-credit students is Learning Frameworks (Education 1300), which helps to build study skills and rarely require demonstrating college readiness. This finding suggests that high school guidance counselors tend to usher younger students into dual-credit courses that do not require students to demonstrate college readiness to prepare them for more rigorous dual-credit courses they will encounter as juniors and seniors, which is consistent with what was reported in the advising component of this study.

Table 1.2. Most Common Dual-Credit Courses Before and After HB 505, by Grade (Percent of All DC SCH Represented by Course)

Ninth and 10th Grade				11th and 12th Grade			
Before HB 505		After HB 505		Before HB 505		After HB 505	
Course	% DC SCH	Course	% DC SCH	Course	% DC SCH	Course	% DC SCH
EDUC 1300	5.07%	EDUC 1300	6.09%	ENGL 1301	11.65%	ENGL 1301	10.99%
SPCH 1311	5.02%	ARTS 1301	4.36%	ENGL 1302	10.99%	ENGL 1302	9.85%
HIST 1302	4.40%	SPCH 1315	4.28%	HIST 1302	7.63%	GOVT 2305	7.03%
ARTS 1301	3.97%	HIST 1302	3.96%	HIST 1301	7.23%	HIST 1302	6.90%
SPCH 1315	3.35%	SOCI 1301	3.63%	GOVT 2305	6.16%	HIST 1301	6.84%
PSYC 2301	3.24%	PSYC 2301	3.40%	ECON 2301	4.65%	ECON 2301	4.31%
HIST 1301	2.97%	SPAN 1411	3.33%	MATH 1314/1414	3.69%	MATH 1314/1414	3.72%
COSC 1301	2.96%	SPCH 1311	2.95%	ENGL 2322	1.90%	ENGL 2322	2.21%
SPAN 1411	2.60%	HIST 1301	2.75%	PSYC 2301	1.75%	PSYC 2301	1.87%
MATH 1314/1414	2.51%	COSC 1301	2.71%	ENGL 2323	1.58%	GOVT 2306	1.80%

Characteristics of Dual-Credit Courses Changed Modestly Since HB 505

We also examined trends in characteristics of dual-credit courses after the passage of HB 505. Figure 1.13 shows changes in key design features of dual-credit courses that we can capture in administrative records before and after the passage of HB 505. The results show that there has been very little change in the characteristics of dual-credit courses since the passage of HB 505. Specifically, the percentage of dual-credit courses taught in a face-to-face format held relatively constant at a little more than 80%. The percentage of dual-credit courses taught on a college campus (as opposed to a high school campus) held constant at roughly 54%.

Figure 1.13. Delivery of Dual-Credit Courses Among Dual-Credit Participants Before and After HB 505 (2012 –17; *n* = 1,868,920)

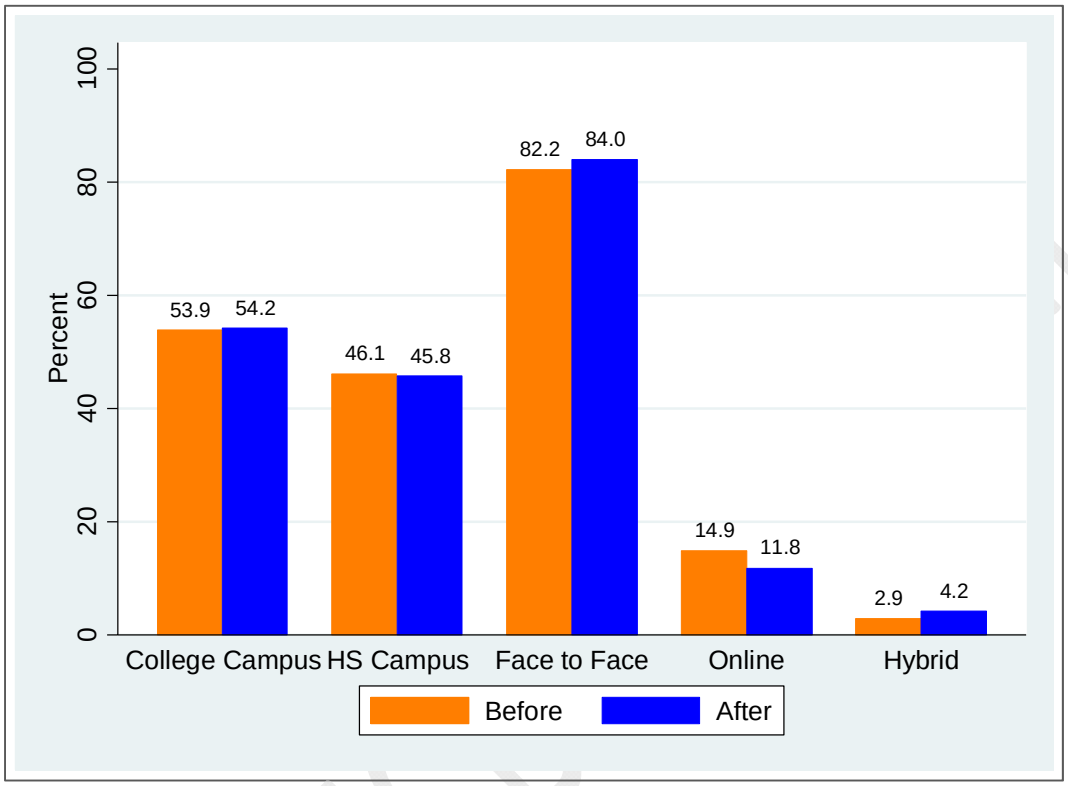
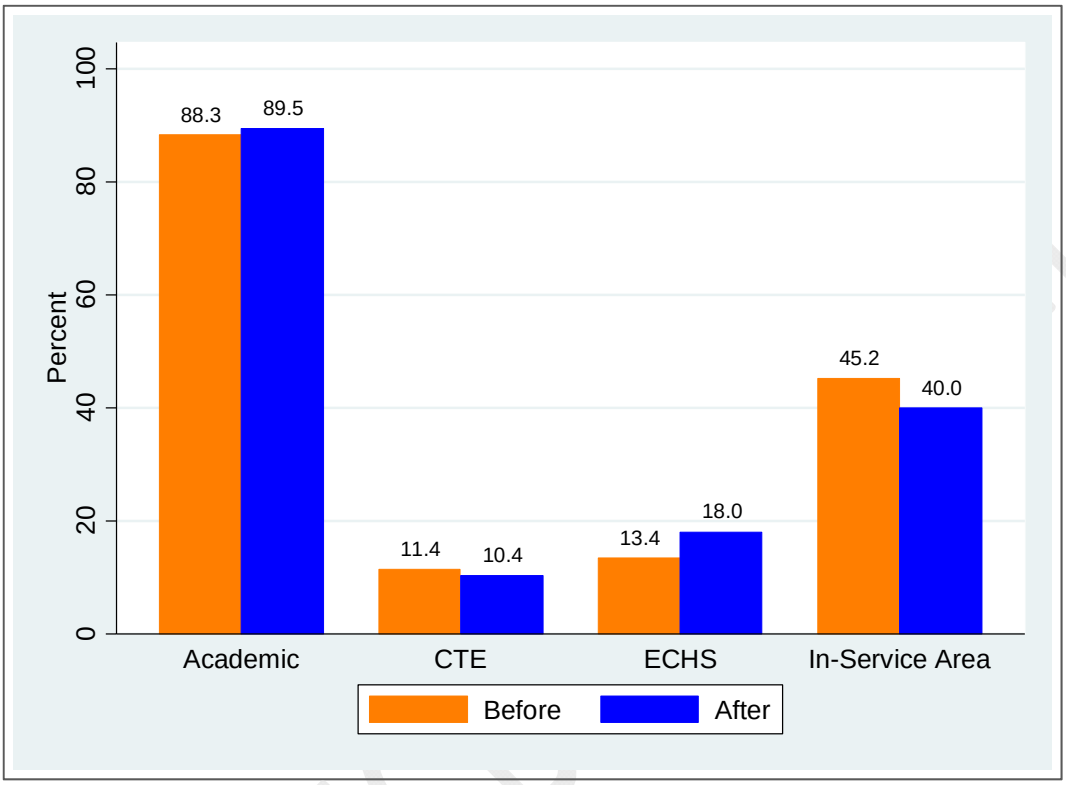


Figure 1.14 shows trends in other course features before and after HB 505. The share of courses that were academic (versus career and technical education [CTE]) held relatively stable at just under 90% (just over 10%). However, the share of courses delivered via an ECHS rose considerably from 13.4% before to 18.0% after HB 505.[7] Finally, given that HB 505 loosened restrictions that required institutions to seek preapproval to develop dual-credit partnerships with high schools outside of their service area, we were interested in whether there was an increase in dual-credit courses delivered to students whose high school was not within the service area of the college. Figure 1.14 shows that the share of dual-credit courses delivered to a high school partner within the service area of the college declined from 45% to 40% since HB 505.

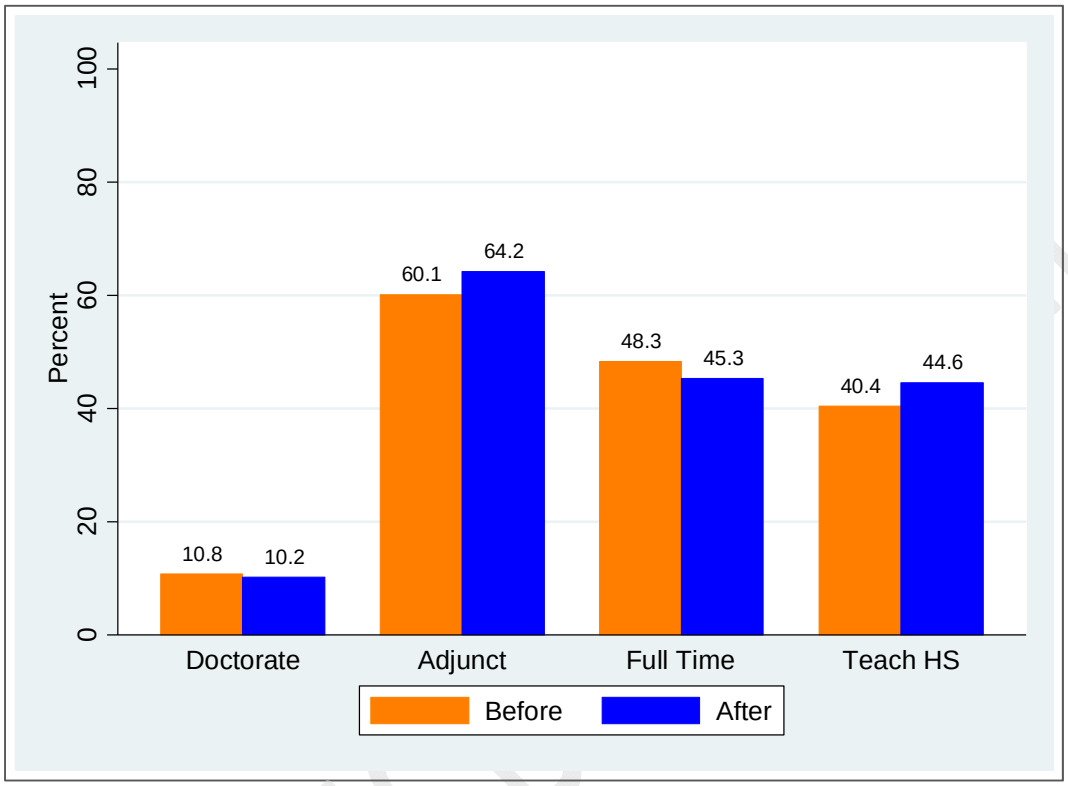
[7] We use a revised estimate of ECHS students. Previously, we assumed if anyone at a campus with an ECHS took DC then they were an ECHS student. We can directly observe who is an ECHS student in 2017, but not before. We take the rate of true ECHS students in 2017 and use that to project back, giving a better estimate. We initially found 14.5% of students were ECHS before HB 505 and 20.1% after HB 505. Using the revised estimate, we find 13.4% of students were ECHS before HB 505 and 18.0% after HB 505.

Figure 1.14. Type of Dual-Credit Courses Among Dual-Credit Participants (2012–17; *n* = 1,868,920)



We also examined whether the characteristics of faculty teaching dual-credit courses changed since HB 505. Figure 1.15 demonstrates that the share of dual-credit courses taught by adjunct instructors increased from 60.1% to 64.2% since the passage of HB 505. The share of dual-credit courses taught by high school teachers also increased from 40.4% to 44.6%. The share of dual-credit courses taught by an instructor with a doctorate held relatively stable at a little more than 10%.

Figure 1.15. Faculty Characteristics of Dual-Credit Courses at Two-Year Colleges (2012–17; *n* = 1,268,365)



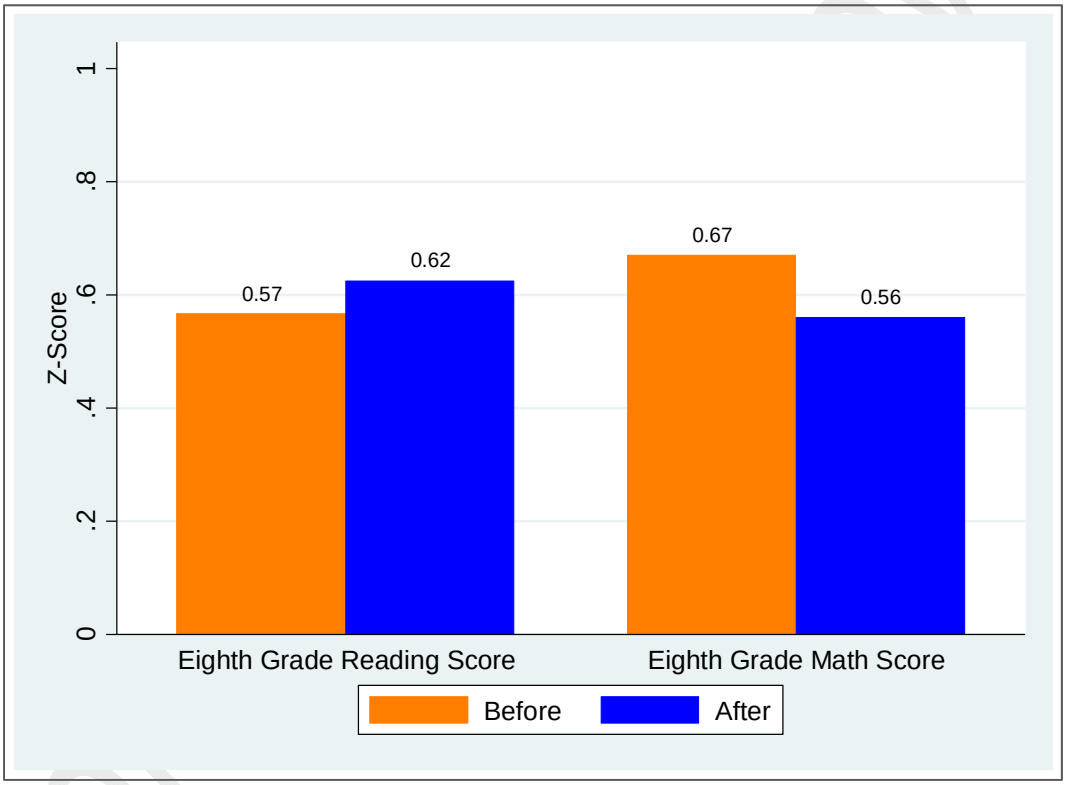
Changes in Academic Preparation of Dual-Credit Participants

Little Evidence That Overall Academic Preparation of Dual-Credit Participants Systematically Changed Since HB 505

Given that HB 505 allowed 9th and 10th graders to enroll in dual-credit courses and prevented the state from limiting the number of dual-credit courses that students could enroll in, some stakeholders voiced concerns that this might lead to an increase in the number of underprepared students taking dual-credit courses in high school. To assess this concern, we analyzed trends in academic preparation of dual-credit participants before and after the passage of HB 505. Figure 1.16 shows the average score on the eighth-grade statewide assessment (the TAKS and STAAR) in both reading and mathematics among dual-credit participants before and after the passage of HB 505. Here, the scores were centered around the mean test score among all Texas public school eighth grade test takers, which is set at zero. Thus, a one-point increase represents a test score that is a full standard deviation above the mean. Figures 1.16 shows that before and after the passage of HB 505, dual-credit participants scored above the average on eighth-grade mathematics and reading standardized tests, which

suggests that they are more academically prepared than the average eighth-grade student. Examining changes after Texas loosened restrictions around dual-credit enrollment, our result show that, while the average eighth-grade reading test scores of dual-credit participants marginally increased from 0.57 to 0.62 standard deviations above the mean, the average TAKS and STAAR mathematics score also slightly decreased from 0.67 to 0.56 standard deviations above the mean. These results provide little evidence that the academic preparation of dual-credit participants changed in a systematic way since the passage of HB 505.

Figure 1.16. Average Score on the Eighth-Grade Standardized State Assessment (TAKS and STAAR Examinations) Among Dual-Credit Participants (2012–17; *n* = 620,716)

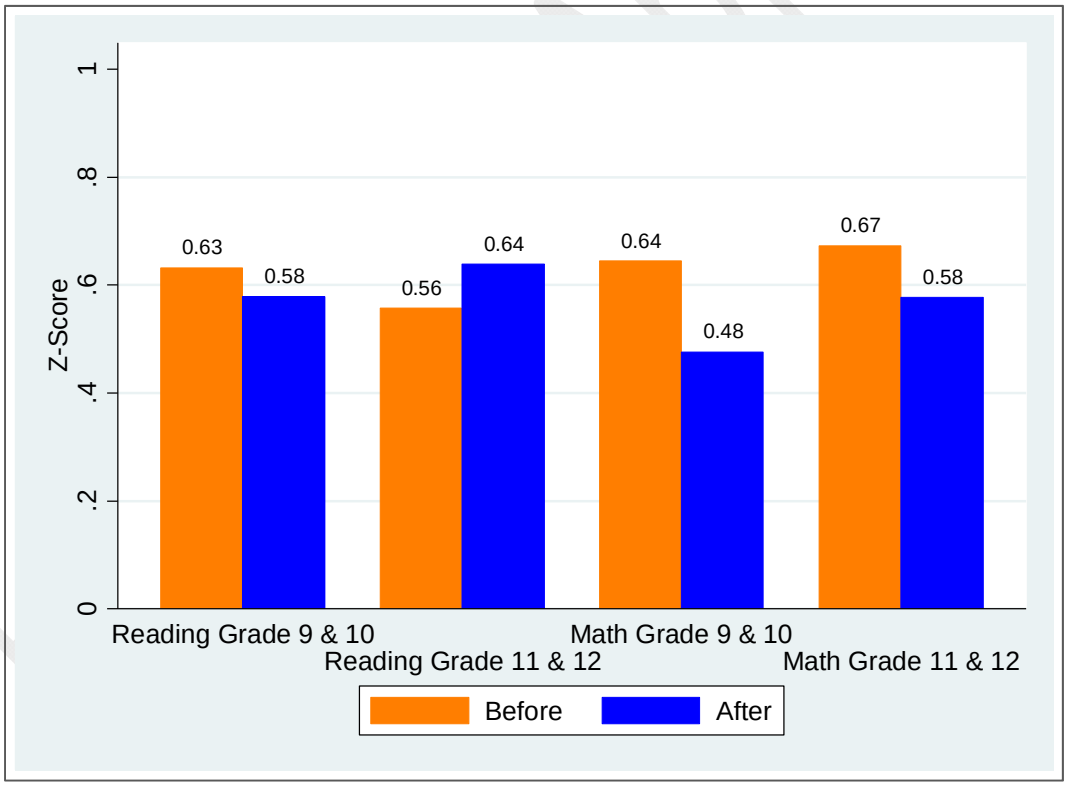


Academic Preparation of Ninth- and 10th-Grade Dual-Credit Participants Has Declined Since HB 505, But is Still Above the Statewide Average for Those Grades

HB 505 also prohibits the state from implementing rules that prevent ninth and 10th graders from enrolling in dual-credit education, so we investigated the extent to which the academic preparation of ninth and 10th graders has shifted given that younger students can now enroll in dual-credit coursework. Figure 1.17 breaks the data presented in Figure 1.16 out by grade. Akin to results presented in Figure 1.16, results show that dual-credit participants across all grades

scored about half a standard deviation above the average on the state's standardized tests in eighth grade reading and mathematics, which shows that dual-credit students are academically superior students. However, results also show that the reading and mathematics test scores of ninth and 10th graders participating in dual-credit declined after the passage of HB 505. Notably, the typical ninth- and 10th-grade dual-credit student had a mathematics test score that was 0.64 standard deviations above the average before HB 505, but just 0.48 standard deviations above the average after HB 505. Results show a similar decline in reading, as the mean reading test score for ninth and 10th graders declined from 0.63 to 0.58 standard deviations above the mean after HB 505 passed. Although these results show that freshmen and sophomores who took dual credit before HB 505 were more academically prepared than those who took dual credit after HB 505, it is nevertheless important to note that students pre- and post-HB 505 scored significantly higher than the statewide average in both subjects.

Figure 1.17. Average Score on the Eighth-Grade Standardized State Assessment (TAKS and STAAR Examinations) Among Dual-Credit Participants by Grade (2012–17; *n* = 620,716)

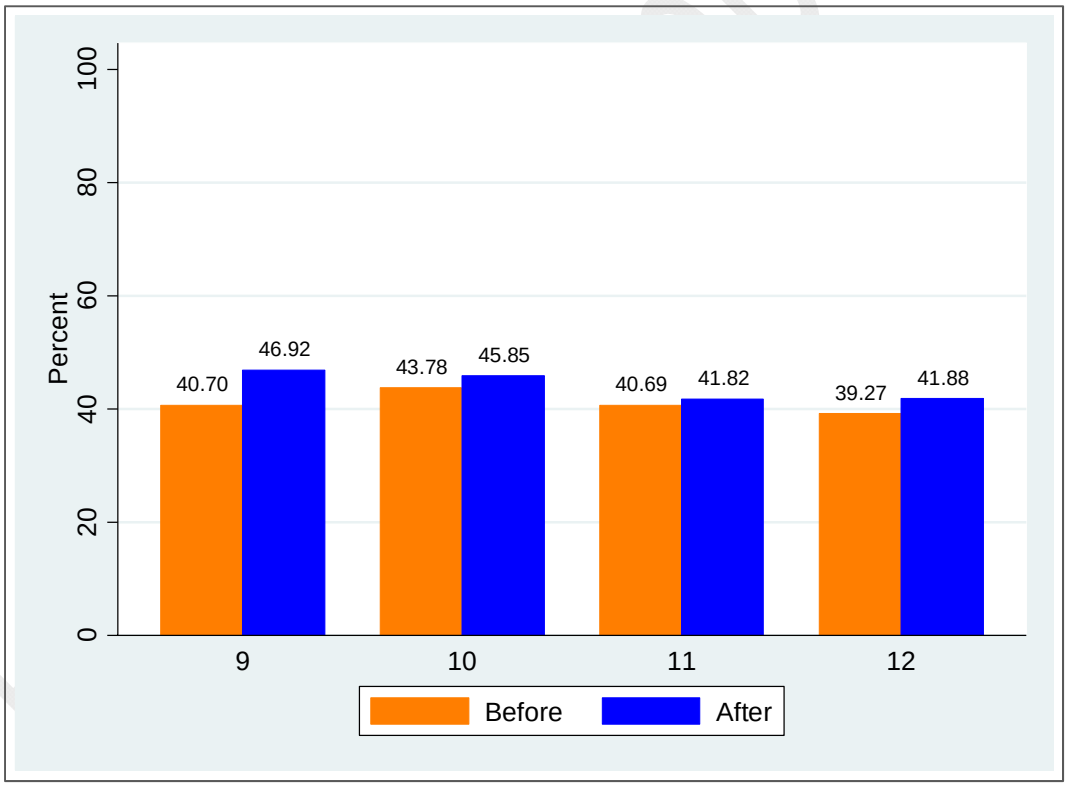


Changes in Dual-Credit Course Performance

Slightly Higher Grades in Dual-Credit Courses Since HB 505, Particularly for Ninth Graders

Given the decline in mathematics and reading test scores of ninth and 10th grade dual-credit participants since the passage of HB 505, one might be concerned that these less prepared students would have lower success rates in their dual-credit courses. To assess these concerns, Figure 1.18 shows the share of dual-credit participants receiving an A in their dual-credit course by grade. The results demonstrate that course grades increased slightly after HB 505 for all groups, but particularly for ninth graders. Prior to HB 505, about 40.2% of dual-credit course grades overall were As and that number increased to 42.5% after HB 505. Among ninth grade dual-credit participants, the share of course grades that were As increased from 40.7% to 46.9% since HB 505.

Figure 1.18. Share of Dual-Credit Course Grades That Were As by Grade (2012–17; *n* = 1,868,920)



Higher Grades in College Algebra (Math 1314/1414) and English Composition I (English 1301) Since HB 505

To further assess trends in dual-credit course grades since the passage of HB 505, we looked at the distribution of course grades in two common dual-credit courses: College Algebra (Math 1314/1414) and English Composition I (English 1301). Figures 1.19 and 1.20 show the distribution of course grades in those subjects before and after the passage of HB 505. The results show that in both courses, the grade distribution shifted significantly upward, with more As and fewer Bs or lower. For example, the share of course grades that were As in Math 1314/1414 increased from 37.5% to 40.1% after HB 505, with grades that were Bs and lower correspondingly decreasing. A Kolmogorov-Smirnov test of distribution equality confirmed that this upward shift in the dual-credit course grade distribution for both courses was statistically significant.

Figure 1.19. Distribution of Dual-Credit Course Grades in College Algebra (Math 1314/1414) (2012–17; *n* = 87,853)

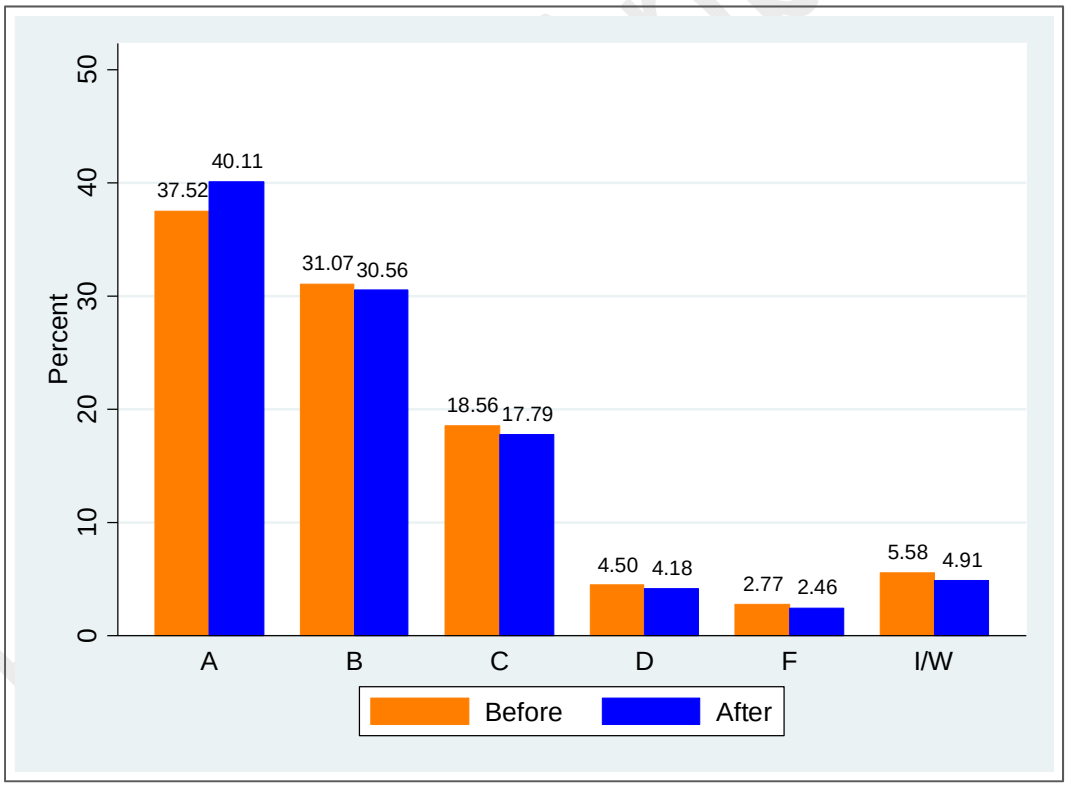
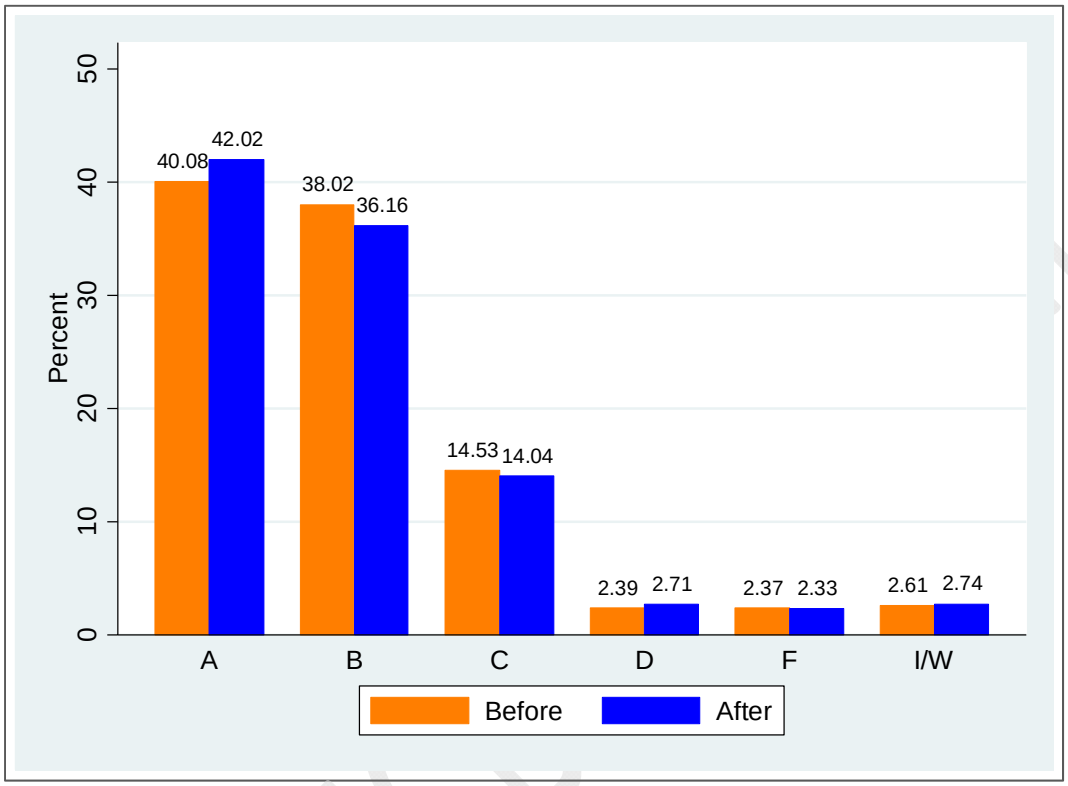


Figure 1.20. Distribution of Dual-Credit Course Grades in English Composition I (English 1301) (2012–17; *n* = 192,174)



Causal Impact Study

Approach to Question 3

In Phase I, RAND found that prior to HB 505, students who participated in dual-credit outperformed students who did not. Results from Phase I showed that dual-credit students had higher grades in dual-credit courses in the same subject as their nondual-credit peers and higher grades in follow-on courses in the same subject. Dual-credit students also had higher college enrollment rates after they graduated from high school, particularly at four-year colleges, and were significantly more likely to persist in and complete college. Moreover, dual-credit students took, on average, half an academic year less to complete a four-year degree, yet completed their degrees with roughly the same number of SCH as students who did not take a dual-credit course, which suggests that dual-credit students, like their counterparts, equally suffer from the problem of excess credit hours.

Although the findings from Phase I suggest that dual-credit education may usher in more success for students, they also demonstrated that students who took dual-credit courses were less likely than nonparticipants to be underrepresented minorities or eligible for free or reduced-price lunch and more likely to be considered gifted and talented—all factors that are generally positively related to academic outcomes. Based on the descriptive analysis conducted in Phase I, RAND could not determine the extent to which the benefits experienced by dual-credit participants were directly attributable to their participation in dual-credit education or to other factors such as their level of academic preparation or motivation to succeed.

To isolate the impact of dual-credit education on student outcomes, we designed a quasi-experimental approach that takes advantage of changes in the timing and the rate of students participating in dual-credit education programs across high schools in Texas. By employing this advanced approach, or what economists call an *instrumental variable identification strategy*, we are able to compare outcomes for similar students, the only difference being that one group of students had more access to and enrolled in dual-credit education whereas the other group of students did not have the same access and did not enroll in dual credit. In our estimation, we also control directly for a number of student characteristics, including race/ethnicity, free or reduced-price lunch eligibility, eighth grade standardized test scores, and differences across high schools and cohort years. For the sake of continuity, we focus on the same set of outcomes from Phase I, namely, college enrollment and completion, time-to-degree, and SCH-to-degree, and add new ones, namely, high school graduation, and completion of a workforce certificate. For this analysis, we examine outcomes for juniors enrolled in Texas public high schools starting in 2001 and ending in 2016.

A number of factors may cause estimates from our IV model to misstate the true impact of dual-credit participation, but the most likely sources of bias would cause our estimates to overstate the impact. As described above, we also maintain that estimates of the impact of dual-credit participation that are based on descriptive data are also likely to overstate the true impact of dual credit because they are unable to capture factors like motivation and desire to enroll in college that are jointly related to dual-credit participation and college outcomes. Since our estimates for the impact of dual credit are smaller than what have been reported in past descriptive studies, we believe that our estimates are more reasonable and closer to the truth than any that have been reported in the past. We describe our econometric approach in detail in Appendix A, and we describe the potential limitations of the methodology and likely sources of bias in more detail at the close of the chapter.

It is important to note that we estimate the impact of dual credit using two different measures of dual-credit participation: an indicator for whether a student took at least one dual-credit course in his or her junior or senior year of high school, and an indicator for the number of semester credit hours of dual-credit courses a student took during his or her junior and senior year of high school. We refer to estimates using the former indicator as estimates of the average effect of dual-credit participation, while we refer to estimates using the latter indicator as the dosage effect of dual credit. In Appendix A, we demonstrate that the estimates for the average effect of dual credit are analogous to and consistent with the dosage effect of dual credit for a student who took the average number of SCH of dual credit among dual-credit participants. Thus, we focus our discussion of findings in the body of the report on the average effect of dual credit, but we present findings for the dosage effect of dual credit in Appendix A.

It is also important to note that our causal impact study focuses only on the impact of traditional dual-credit courses that were delivered prior to HB 505. As such, we are unable to speak to the impact of ECHSs or the impact of dual credit since HB 505. We decided to focus on dual-credit programs offered through traditional high schools because this is how most students experience dual-credit education, not through unique programs like ECHS, which provide robust student supports mandated by the Texas Education Agency. According to our analysis of THECB data, during the 2016-17 academic year, 17% of all students who took dual credit and 22% of all SCH of dual credit delivered statewide were delivered in the context of an ECHS. Also, experimental studies, including one by AIR, had already documented the positive effects of ECHS for a wide range of students, including those who are historically underrepresented in postsecondary education (Berger, Tuck-Bicacki, Garet, Knudson, & Hoshen, 2014; Edmunds et al., 2015). Finally, our study design, which leveraged differences over time and across schools in the share of students participating in dual-credit, did not allow us to assess the impact of dual-credit courses delivered by ECHSs. This is because, by design, all students within an ECHS take dual-credit courses. Finally, because HB 505 was just passed in 2015, there is an insufficient number of junior cohorts that experienced dual-credit since HB 505 to observe postsecondary outcomes. Each of these topics is worthy of future research.

Dual-Credit Participation Is Strongly Associated With Positive Student Outcomes

In Phase I, RAND's analysis was based on cohorts of Texas public high school graduates, whereas ours is based on cohorts of Texas public high school juniors. To document that our data exhibits similar patterns as those reported by RAND in Phase I, Table 1.3 presents data on the outcomes of Texas public high school juniors by dual-credit participation status. The results confirm those from Phase I and demonstrate that dual-credit participants had much better

outcomes on average than did nonparticipants. In particular, while 80.6% of high school juniors who did not take dual-credit graduated from high school within two academic years, the corresponding figure for dual-credit participants was 94.7%. With respect to college enrollment, 48.5% of nonparticipants enrolled in any postsecondary program three years after their junior year, whereas the corresponding figure for dual-credit participants was 79.4%. With respect to college completion, 21.6% of nonparticipants had completed any postsecondary credential within 10 years of their junior year of high school, whereas the corresponding figure for dual-credit participants was 54.6%.

Table 1.3. Mean Student Outcomes by Dual-Credit Participation (2001–16)

Outcome	No Dual Credit	Dual Credit	Cohorts
Graduate high school	80.6%	94.7%	2001–16
Enroll two-year	29.8%	31.9%	2001–15
Enroll four-year	20.3%	51.7%	2001–15
Enroll four- or two-year	48.5%	79.4%	2001–15
Complete two-year	14.3%	26.3%	2001–13
Complete four-year	19.7%	51.4%	2001–08
Complete two- or four-year	21.6%	54.6%	2001–08

Dual Credit Participation Increases High School Completion Rates by 0.7 Percentage Points

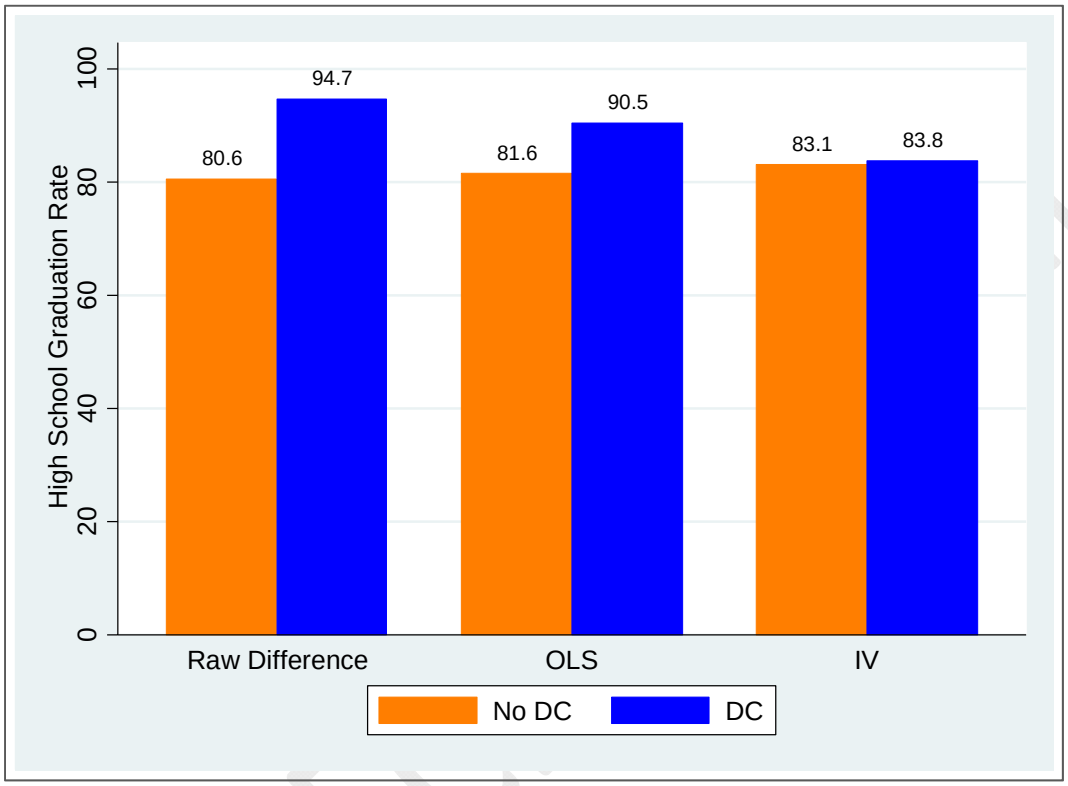
Although the results presented in Table 1.3 suggest that students respond positively to dual-credit education, they do not provide proof that dual-credit participation directly improves student outcomes. After all, we know that dual-credit students are more academically prepared than nondual-credit students, so we would expect them to have better outcomes even if they had never enrolled in dual-credit education. To improve the analysis presented previously, we directly compare outcomes for dual-credit and nondual-credit students who are similar across a range of dimensions. We accomplish this by running simple Ordinary Least Squares (OLS) regression models that control directly for a student's level of academic preparation, race/ethnicity, and gender, among other dimensions. Although these models match students on what economists call observable characteristics, or factors that can be easily documented with quantitative data, they do not include other dimensions students may differ on, including motivation, self-efficacy,

or desire to go to college. To account for these dimensions in our analysis, we employed our Instrumental Variable (IV) model that is described in detail in Appendix A.

Figure 1.21 presents results estimating the impact of dual-credit participation on high school degree completion. The first set of columns shows the raw, unadjusted high school completion rate for dual-credit participants and nonparticipants. The second set of columns presents results from our OLS models that adjust differences in high school completion rates by dual-credit participation status based on differences in observable student characteristics including race/ethnicity, free or reduced-price lunch status, and standardized test scores in eighth grade reading and mathematics. The models also include a high school fixed effect, which accounts for differences in the types of high schools attended by dual-credit participants and nonparticipants and a cohort fixed effect, which accounts for differences across junior cohorts. The third set of columns, present the results from our IV models, which account for unobserved factors like motivation, self-efficacy, and desire to go to college, and can be interpreted as the causal impact of dual-credit participation on high school completion. Results presented in Figure 1.21 clearly indicate that models that do not control for the characteristics of students who enroll in dual credit produce biased estimates of the impact of dual-credit education programs. In column 1, we see that the high school completion rate among dual-credit participants was 94.7%, noticeably higher than nonparticipants at 80.6%: a difference of 14.1 percentage points. When we control for factors like race, free or reduced-price lunch eligibility and prior academic preparation, the estimate of the impact of dual-credit education on student decreases, suggesting that observable characteristics account for some, but not all, of the difference in high school completion rates among dual-credit participants and nonparticipants. Specifically, although the adjusted high school completion rate among dual-credit participants was 90.5%, the corresponding rate among nonparticipants was 81.6%, a difference of 8.9 percentage points.

Finally, the third set of columns present results from our IV model, which account for unobserved factors and can be interpreted as the causal impact of dual-credit participation on high school completion. At first glance, we notice that estimates presented in the third column are significantly smaller than those in the first and second set, which suggests that most of the observed differences in high school completion by dual-credit participation are driven by selection on unobservable variables that OLS and descriptive statistics are unable to account for. Although the fully adjusted high school completion rate among dual-credit participants was 83.8%, the corresponding rate among nonparticipants was 83.1%. The difference of 0.7 percentage points is not statistically different from zero in this case. We thus find no evidence that dual-credit participation increases high school completion.

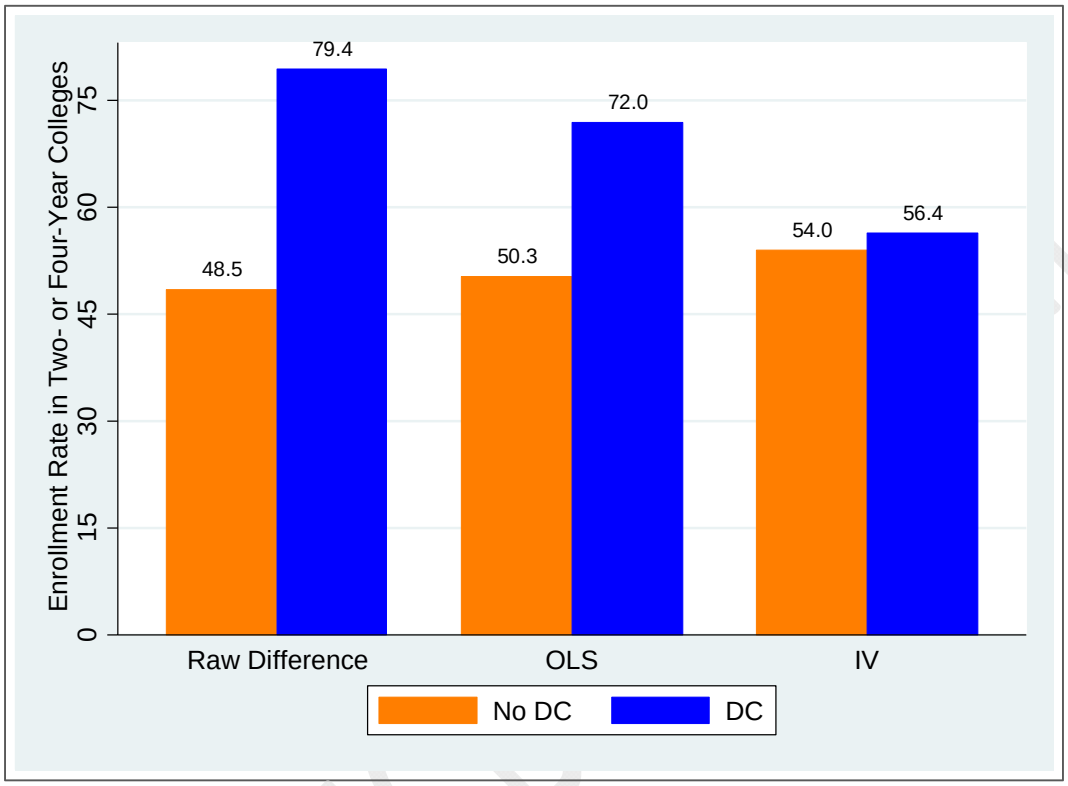
Figure 1.21. Causal Impact of Dual-Credit Participation on High School Completion (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–16; *n* = 3,411,286)



Dual-Credit Participation Increases College Enrollment by 2.4 Percentage Points

Figure 1.22 replicates Figure 1.21 using college enrollment as the outcome. Results suggest that most, but not all, of the difference in college enrollment rates among dual-credit participants and nonparticipants is driven by self-selection into dual-credit programs or, in other words, the characteristics of students who enroll in dual-credit programs. The raw unadjusted difference in college enrollment rates, presented in the leftmost columns, show that dual-credit participants were 30.9 percentage points more likely to enroll in a two- or four-year college within two years after their junior year of high school. However, the rightmost columns demonstrate that once we fully account for observable and unobservable characteristics of students who enroll in dual-credit education into the model, this difference drops to just 2.4 percentage points. Although this represents a large and meaningful increase in college enrollment that is attributable to dual-credit participation, it is much more modest than what has been found in past descriptive research, including the results that were presented in the Interim Report.

Figure 1.22. Causal Impact of Dual-Credit Participation on College Enrollment (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–15; *n* = 3,223,430)

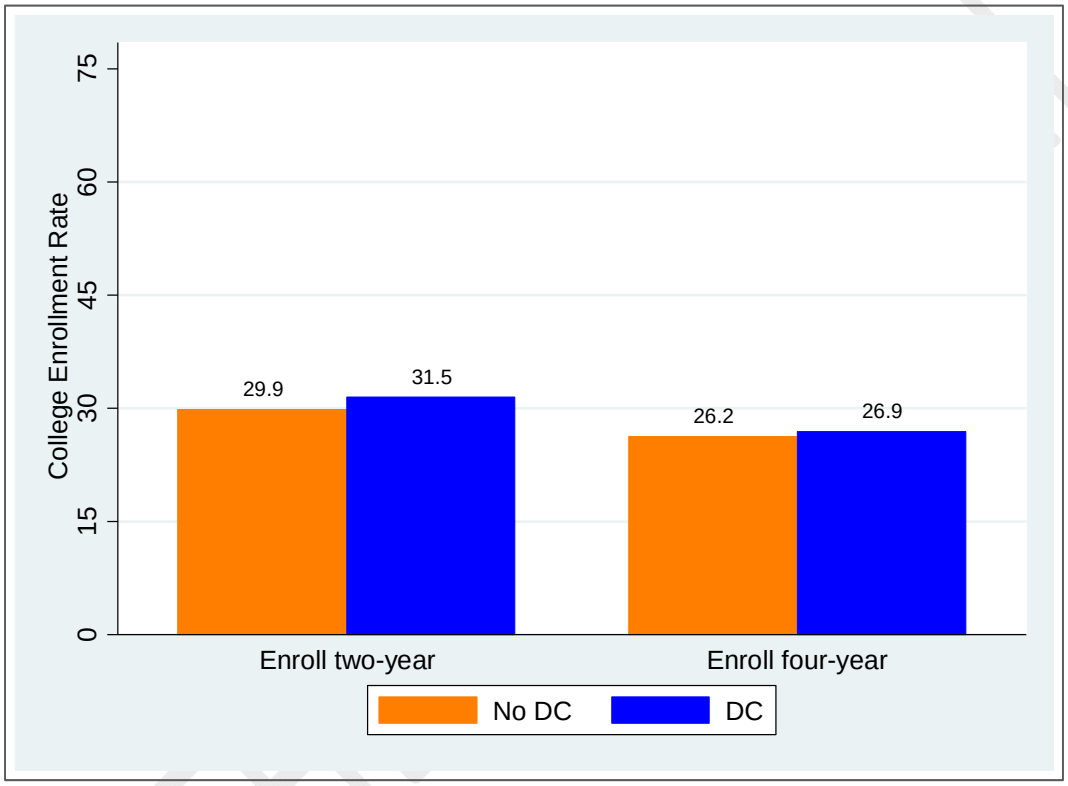


Impact of Dual-Credit Participation on College Enrollment Driven by Enrollment at Two-Year Colleges

We wanted to assess the extent to which the increase in college enrollment attributable to dual-credit participation channels through two- versus four-year colleges, so we ran our favored IV model separately for enrollment in a two-year college and enrollment in a four-year university. Results from both models are presented in Figure 1.23 below. The leftmost set of columns shows the predicted enrollment rate at two-year colleges for dual-credit participants and nonparticipants. The rightmost set of columns replicates the analysis for four-year universities. Results demonstrate that participation in dual-credit education increased the probability of enrolling at a two-year college by 1.6 percentage points, but we do not find a statistically significant impact on enrollment at four-year colleges. This suggests that the

increase in college enrollment attributable to dual-credit participation primarily channels through two-year colleges.[8]

Figure 1.23. Causal Impact of Dual-Credit Participation on Two- Versus Four-Year College Enrollment (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–15; *n* = 3,223,430)



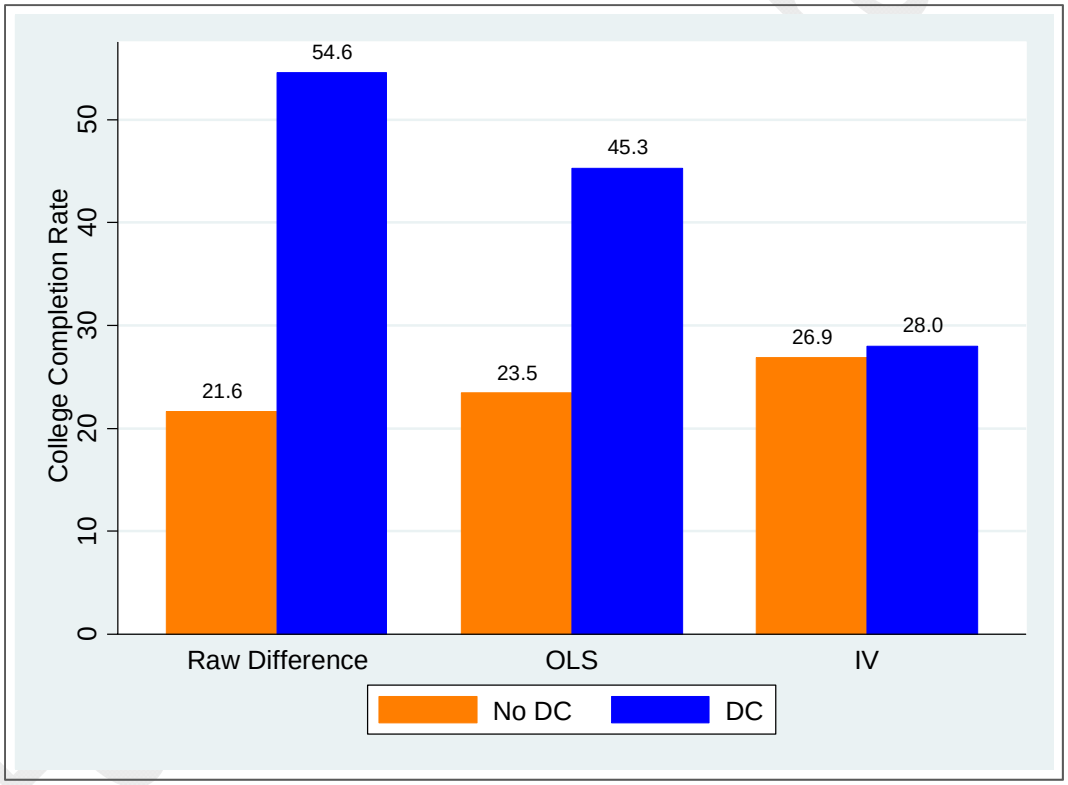
Dual Credit Participation Increases College Completion by 1.1 Percentage Points

Figure 1.24 replicates Figure 1.21 using college completion as the outcome. Here, we define college completion as completing a four- or two-year degree or any certificate program at a public or private nonprofit college in Texas within 10 years of a student's junior year of high school. We use a 10-year follow-up window to ensure sufficient time for nondual-credit participants to catch up with participants and also because many students who start at two-year colleges take upward of eight years to complete a four-year degree and may never obtain a two-year degree along the way. The results suggest that most, but not all, of the difference in

[8] This finding is consistent with the fact that the vast majority of dual credit courses in Texas are delivered through two-year colleges. If participating in dual credit helps students get familiar with the college partner delivering the dual credit course, students may be more likely to enroll in that college after graduating high school. Indeed, some colleges cite dual credit as a major recruitment tool.

college completion rates among dual-credit participants and nonparticipants is driven by selection. The raw unadjusted difference in college completion rates, presented in the leftmost columns, show that dual-credit participants were 33.0 percentage points more likely to complete a college credential within 10 years after their junior year of high school. However, the rightmost columns demonstrate that once we fully adjust for selection into dual credit, this difference drops to an insignificant 1.1 percentage points. Although this represents a meaningful increase in college completion rates that is attributable to dual-credit participation, it is much more modest than what has been found in past descriptive research, including the results that were presented in the Interim Report.

Figure 1.24. Causal Impact of Dual-Credit Participation on College Completion (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–08; *n* = 1,542,629)



Impact of Dual-Credit Participation on College Completion Driven by Completion at Two-Year Colleges

Figure 1.25 presents estimates measuring the impact of dual-credit education on completing a college credential from a community college and also on a four-year degree. To measure college completion from a community college, we track students five years after their junior

year and consider them as "completers" if they obtain a two-year degree or any certificate or if they transfer up to any public nonprofit college in Texas during that time frame. To measure college completion from a four-year university, we examine whether they completed a bachelor's degree within 10 years of initially enrolling as a high school junior. Figure 1.25 presents our results. The leftmost set of columns shows the predicted completion rate at two-year colleges for dual-credit participants and nonparticipants. The rightmost set of columns replicates the analysis for four-year colleges. The results demonstrate that dual-credit participation increases the completion rate at two-year colleges by 3.5 percentage points. In contrast, we find that dual-credit participation increases the probability of completing a four-year degree by a more modest 0.3 percentage points. This suggests that the increase in college completion attributable to dual-credit participation primarily channels through two-year colleges, but dual-credit participation does modestly increase the probability of completing a four-year degree.

Figure 1.25. Causal Impact of Dual-Credit Participation on Two- Versus Four-Year College Completion (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–13; *n* = 2,754,765)

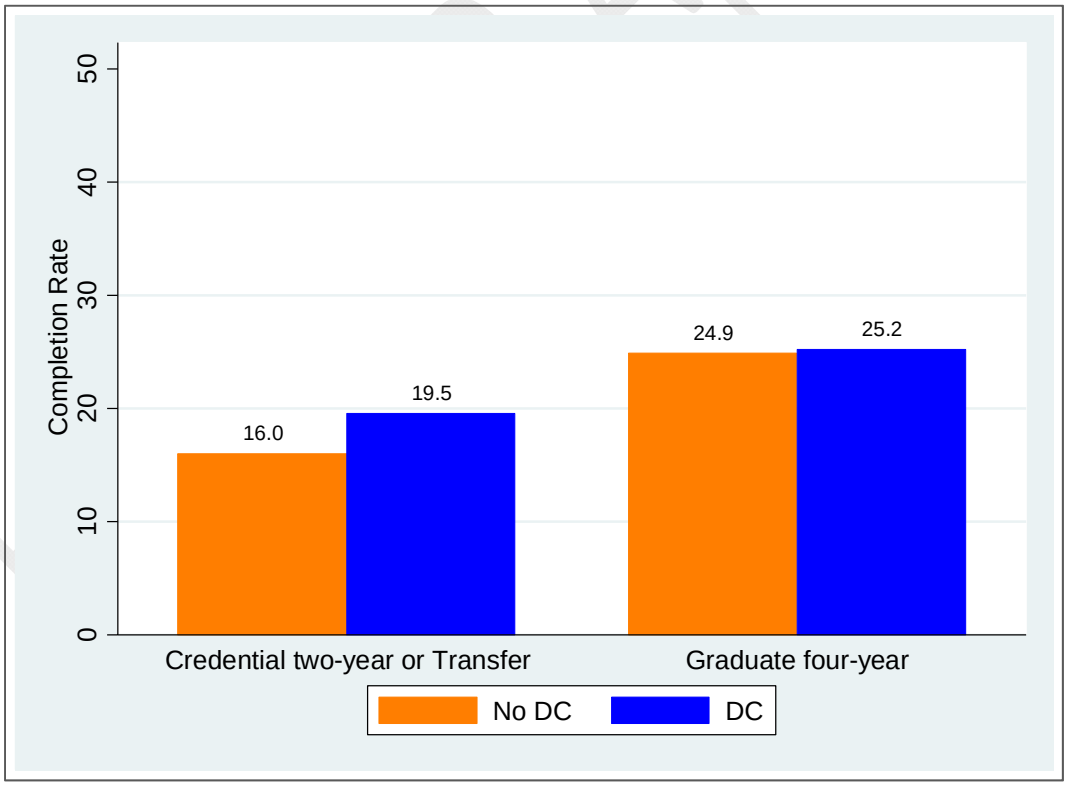
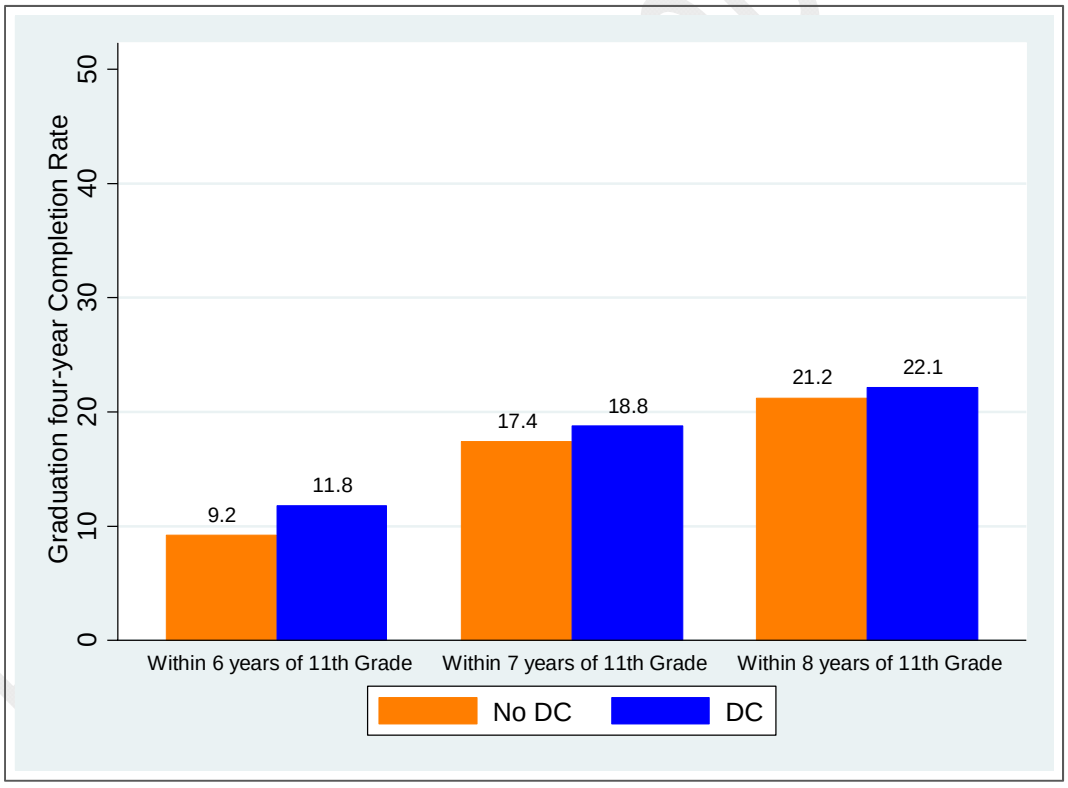


Figure 1.26 presents estimates measuring the impact of dual-credit education on completing a four-year degree with different time windows. To measure college completion from a four-year university, we examine whether they completed a bachelor's degree within 6, 7, and 8 years of initially enrolling as a high school junior. Figure 1.26 presents our results. The leftmost set of columns shows the predicted completion rate at four-year colleges for dual-credit participants and nonparticipants with 6 years, with the time window increasing with columns on the right. The results demonstrate that dual-credit participation increases the completion rate at four-year colleges by 2.6 percentage points within 6 years of a student's junior year. That advantage decreases over time to 1.4 percentage points within 7 years of a student's junior year and decreases further to 0.9 percentage points within 8 years of a student's junior year.

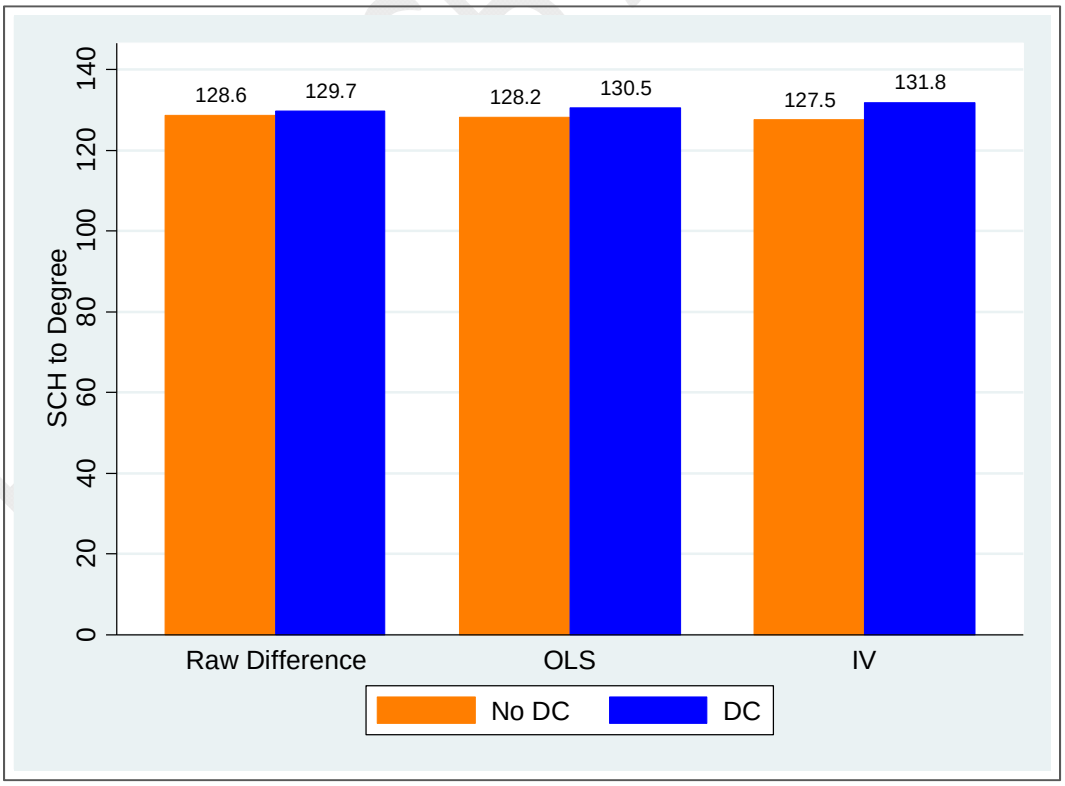
Figure 1.26. Causal Impact of Dual-Credit Participation on Four-Year College Completion with different timing (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–13; *n* = 1,542,629)



Dual-Credit Participation Slightly Increases SCH-to-Degree

Figure 1.27 replicates Figure 1.21 using SCH-to-degree as the outcome. Here, we restrict our sample to students who completed a four-year degree within 10 years after their junior year of high school and count the total number of SCHs that students earned, including those earned as dual-credit in high school, before obtaining their degree. The results in Figure 1.26 suggest that the difference in SCH-to-degree among dual-credit participants and nonparticipants is not as sensitive to selection patterns as the outcomes we have examined so far. The raw unadjusted difference in SCH-to-degree, presented in the leftmost (blue) columns, show that dual-credit participants completed their degrees with an average of 129.7 SCH, while nonparticipants completed their degrees with an average of 128.6 SCH. The difference is a modest 1.1 SCH. The rightmost columns demonstrate that once we fully adjust for selection into dual credit, this difference increases to 4.3 SCH. Although this is a modest increase in SCH-to-degree, it is important to note that SCH-to-degree among both dual-credit participants and nonparticipants is quite high and well above the 120 SCH required under most four-year degree plans.

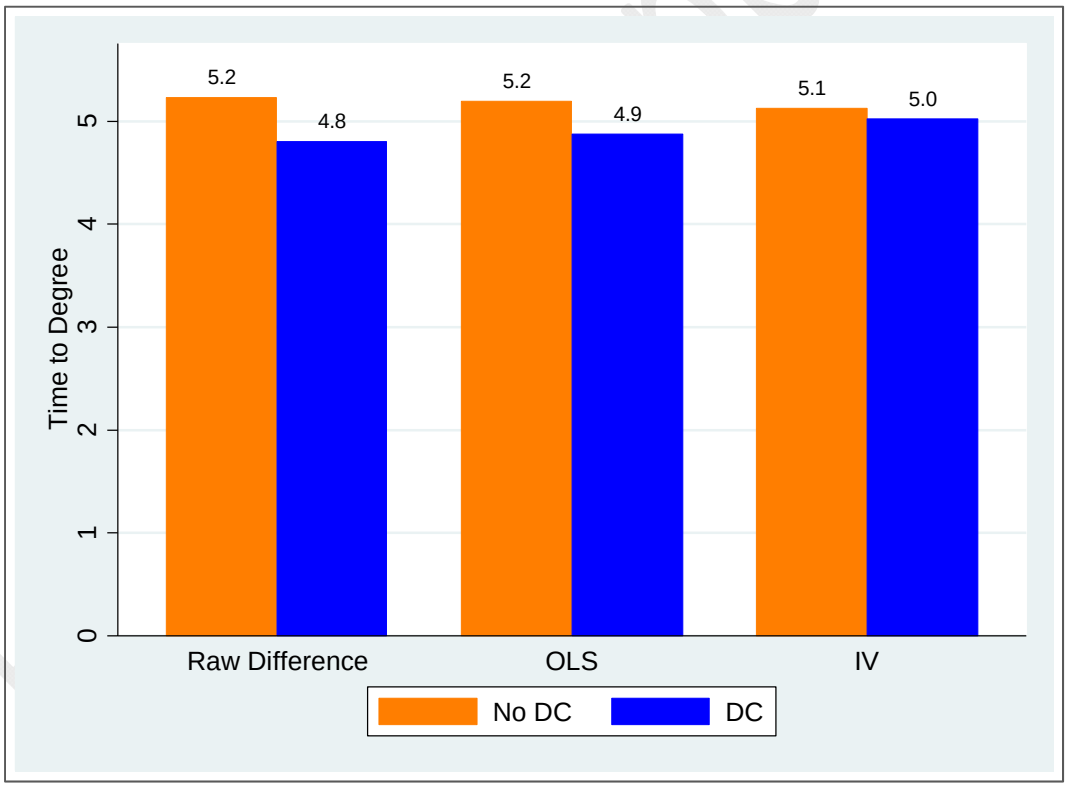
Figure 1.27. Causal Impact of Dual-Credit Participation on SCH-to-Degree (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade Who Graduated From a Four-Year College: 2001–08; *n* = 384,658)



Dual-Credit Participation Reduces Time-to-Degree by Approximately One Summer Term

Figure 1.28 replicates Figure 1.21 using time-to-degree as the outcome. Like those for SCH-to-degree, the results in Figure 1.28 suggest that the difference in time-to-degree among dual-credit participants and nonparticipants is not as sensitive to selection patterns as other outcomes. The raw unadjusted difference in time-to-degree, presented in the leftmost columns, show that dual-credit participants completed their degrees in an average of 5.2 years after high school, while nonparticipants completed their degrees in an average of 4.8 years. The difference is a modest 0.4 years. The rightmost columns demonstrate that once we fully adjust for selection into dual credit, this difference decreases to 0.10 years, or approximately five fewer weeks or the length of one summer term.

Figure 1.28. Causal Impact of Dual-Credit Participation on Time-to-Degree (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade Who Graduated From a Four-Year College: 2001–08; *n* = 375,715)

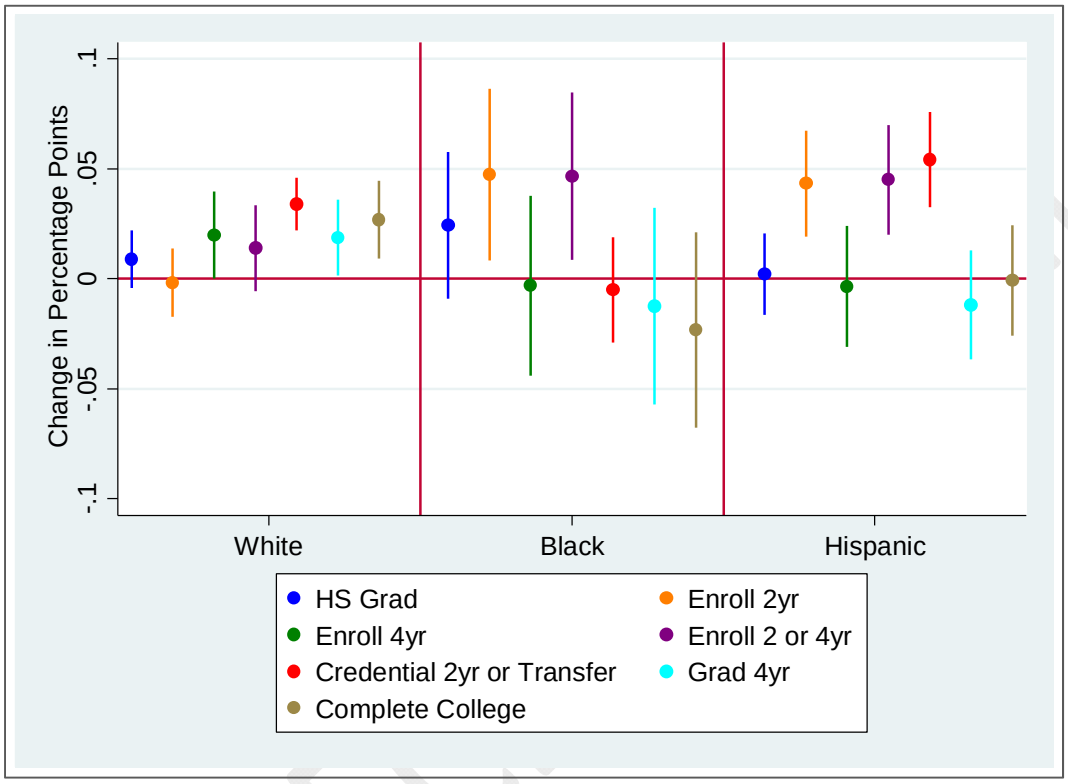


Larger Impact of Dual-Credit Participation on Two-Year College Enrollment but No Impact on Degree Completion for Underrepresented Minorities

Figure 1.29 shows results that assess the extent to which all students benefit from participating in dual-credit education. The leftmost section shows our estimates for the causal impact of dual-credit participation on high school completion, college enrollment (overall, two year, and four year) and degree completion for White students. The center section presents these results for Black students, while the rightmost section presents the results for Hispanic students. Here, the dot represents our estimate of the causal effect of dual-credit participation on the outcome, while the line above and below it represents the 95% confidence interval, which is a range of statistically plausible estimates. When the line crosses zero on the figure, we say that the estimate is not statistically distinguishable from zero, which means that we are unable to say with a reasonable degree of certainty that there is an effect of dual-credit participation on the outcome. The results suggest that dual-credit participation increased enrollment at four-year colleges for White students (by 2.0 percentage points), but significantly increases enrollment at two-year colleges for Black (by 4.7 percentage points) and Hispanic (by 4.3 percentage points) students. We do not find a statistically significant effect of dual-credit participation on two-year college enrollment among White students or on four-year college enrollment among underrepresented minorities.

The results for college completion suggest that dual-credit participation significantly increases completion by 2.7 percentage points among White students, with the increase channeling through both two- and four-year colleges. We also find that dual-credit participation significantly increases completion by 5.4 percentage points at two-year colleges for Hispanic students, but we find no statistical evidence that dual-credit participation increases completion of four-year degrees for Hispanic students. We do not find an increase in college completion at two- or four-year colleges among Black students.

Figure 1.29. Causal Impact of Dual-Credit Participation on Key Outcomes by Race/Ethnicity (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–08; *n* = 1,542,068)



Negative Impact of Dual-Credit Participation on Low Income Students That Is Largely Due to Lower Academic Preparation Among Low Income Students

To assess the extent to which the impact of dual-credit participation varied by the student's economic status, we ran our IV model by whether the student was eligible for free or reduced-price lunch in high school. Results are presented in Figure 1.30. The rightmost section shows our estimates for the key outcomes we used in Figure 1.30 for students who were not eligible for free or reduced-price lunch, while the leftmost section show results for students who are eligible for free or reduced-price lunch. The results suggest that the effect of dual-credit participation varies considerably by the student's economic status, with large positive effects among those who are ineligible and large negative effects for most outcomes among those who are eligible. For example, we find that dual-credit participation increased college enrollment by 5.5 percentage points and college completion by 4.5 percentage points for students who are ineligible for free or reduced-price lunch. Conversely, participating in dual-credit education significantly decreases college enrollment by 3.2 percentage points and significantly decreases college completion by

6.7 percentage points for free or reduced-price lunch eligible students. It is worth noting that our estimate for the effect of taking a dual-credit course on completing a two-year degree or certificate or transferring upward to a four-year college within three years for free or reduced-price lunch eligible students is positive overall but not statistically significant.

To further probe these findings, we also estimated the effect of participating in dual credit for students who are free or reduced price lunch eligible and had eighth grade standardized test scores one standard deviation above the mean. We present these results in Appendix A. The results from this analysis suggest that the negative results for free or reduced-price lunch eligible students were likely due to the fact that free or reduced-price lunch eligible students were more likely than ineligible participants to have lower eighth grade standardized test scores that hindered their success in dual-credit education courses. In particular, we find that free or reduced price lunch eligible students with above average standardized test scores largely benefited from participating in dual-credit education, while those with average eight grade standardized test scores did not.

Finally, it is also important to reiterate that our causal impact analysis does not include dual-credit courses delivered by ECHS. Thus, the negative findings for free or reduced-price lunch eligible students with average eighth grade standardized test scores speak only to the impact of traditional dual-credit education programs. Rigorous experimental studies that have included some Texas ECHSs have documented the positive impact of ECHSs on a range of student outcomes for traditionally underrepresented students.

Figure 1.30. Causal Impact of Dual-Credit Participation on Key Outcomes by Free or Reduced-Price Lunch Eligibility (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–08; *n* = 1,542,068)

Benefits of Dual Credit Vary Considerably by Academic Preparation

We also wanted to assess whether the impact of dual-credit participation varied by academic preparation, so we ran our IV model, interacting the main effect with a student's normed score on the eighth grade TAKS and STAAR exam in mathematics and reading. The results are presented in Figure 1.31 and Figure 1.32. The left panel shows our estimates for the key outcomes for a student scoring at the statewide average on the TAKS or STAAR mathematics and reading standardized test, and the right panel shows results for a student with statewide mathematics and reading scores one standard deviation above the mean.

For better prepared students, we find large positive impacts on college enrollment and completion, particularly at four year colleges. For example, we find that dual-credit participation increases college enrollment and completion by 5.8 and 5.3 percentage points, respectively for students with standardized reading scores that were one standard deviation above the mean. For better prepared students, we also find smaller increases in two-year college enrollment and completion, and no increase in high school completion.

For less academically prepared students, we find a positive impact on high school completion and completion at two year colleges. In particular, we find that dual-credit participation increases the high school completion rate by 1.8 percentage points and completion at two-year colleges by 3.9 percentage points among students with average standardized reading scores. However, for less academically prepared students we find no impact on college enrollment or completion overall or at four-year colleges.

Figure 1.31. Causal Impact of Dual-Credit Participation on Key Outcomes by Eighth-Grade Reading TAKS and STAAR Scores (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–08; *n* = 1,542,068)

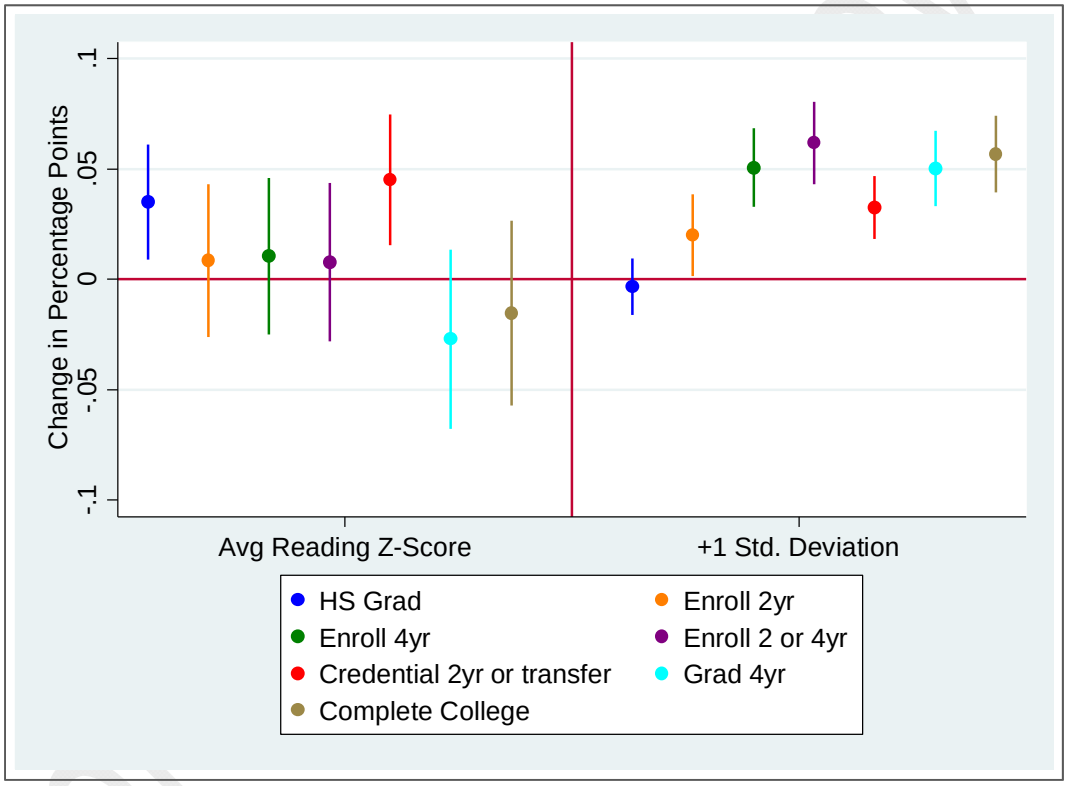
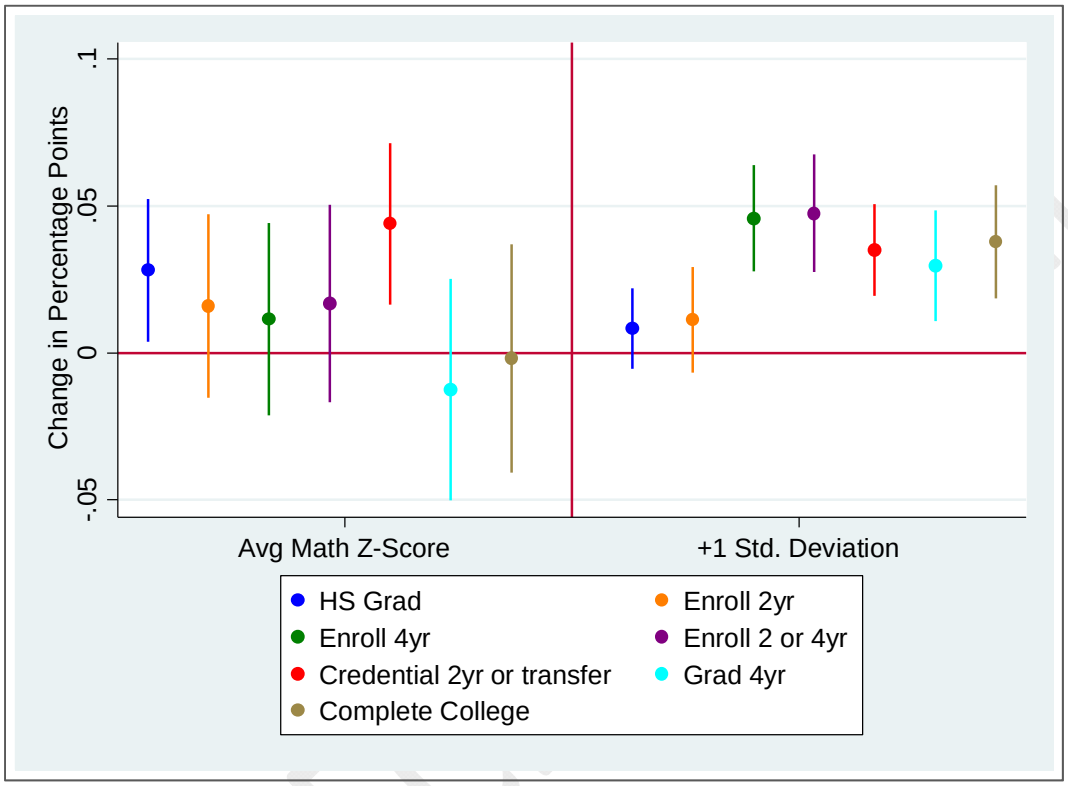


Figure 1.32. Causal Impact of Dual-Credit Participation on Key Outcomes by Eighth-Grade Mathematics TAKS and STAAR Scores (Student Cohorts of Juniors Enrolled in Dual-Credit Education in 11th and/or 12th Grade: 2001–08; *n* = 1,542,068)



Summary, Limitations, and Conclusions

In this chapter, we used quantitative analyses to answer three primary RQs:

RQ 1 What factors contribute to disparities in dual-credit participation?

RQ 2 What changes in dual-credit participation, success, and delivery have occurred since the passage of HB 505?

RQ 3 To what extent does dual-credit participation increase college enrollment, degree attainment, and efficient degree completion?

Racial Disparities Analysis

Differences in academic preparation, income, and high school attendance patterns serve as major contributors to racial and ethnic disparities in dual-credit participation. Our descriptive analyses showed that the dual-credit participation rate of White students was 24.7%, while the corresponding rate for Blacks (Hispanics) was 10.6% (15.6%)—a gap of 14.1 percentage points

(9.1 percentage points). However, when we used regression methods to account for differences in academic preparation and income, those gaps narrowed significantly. For example, our analysis suggested that if Black (Hispanic) students had the same eighth Grade TAKS and STAAR scores as White students, then the gap in dual-credit participation would decrease from 14.1 percentage points (9.1 percentage points) to 6.9 percentage points (3.9 percentage points). We also ran similar models to assess whether differences in access to dual credit, access to AP/IB courses, and access to tuition and fee waivers for dual-credit students also contributed to gaps in dual-credit participation; however, we found little evidence that that these factors made any difference in narrowing these disparities.

HB 505 Analysis

Increase in dual-credit participation and SCH since HB 505, primarily for ninth and 10th graders. Our descriptive analysis showed that dual-credit participation among all ninth through 12th grade students was 7.5% prior to the passage of HB 505 from 2012–15, and increased to 8.5% from 2016–17. This represents a 13% increase in the dual-credit participation rate over a 6 year period. The rate of growth of dual-credit participation was particularly strong for ninth and 10th graders. Ninth graders increased their dual-credit participation rate from 1.0% before HB 505 to 2.1% after, an increase of 110%. Tenth graders increased their dual-credit participation rate by 60% from 2.7% before HB 505 to 4.3% after. There was also a significant increase in the number of SCH taken per dual-credit participant, leading to a continued increase in the number of SCH of dual-credit delivered statewide from 2012–17.

Since the passage of HB 505, the academic preparation of ninth- and 10th-grade dual-credit participants declined while the share of those students receiving A's in their dual-credit courses increased. While ninth- and 10th-grade dual-credit participation remains low relative to participation of 11th and 12th graders, our descriptive analysis showed that dual-credit participation rates of ninth and 10th graders increased significantly in percentage terms after the passage of HB 505. We examined whether there were concomitant changes in academic preparation and dual-credit course pass rates among ninth and 10th-grade dual-credit participants. The results demonstrated that academic preparation among ninth and 10th grade dual-credit participants declined over this period, while dual-credit course pass rates increased for those groups. These patterns were not evident among 11th- and 12th-grade dual-credit participants.

Causal Impact Analysis

Dual-Credit participation improves a range of student outcomes on average, but the causal effect of dual-credit participation is much more modest than what has been reported in past descriptive studies, including the Phase I Interim Report. Past studies have documented that dual-credit participants have better outcomes than nonparticipants. For example, in Phase I, RAND found that, after accounting for some observable characteristics, dual-credit participants had college enrollment (completion) rates that were 17 (21) percentage points higher than those for nonparticipants. Our study replicated these descriptive findings but also used more rigorous econometric methods for causal inference to address selection into dual-credit participation. The results indicated that most, but not all, of the observed difference in student outcomes is due to differences in characteristics of dual-credit participants and nonparticipants. After accounting for selection, dual-credit participation had the following effects:

- Increased college enrollment by 2.4 percentage points primarily through an increase in enrollment at two-year colleges
- Insignificantly increased college completion by 1.1 percentage points by increasing attainment of all types of postsecondary credentials
- Increased total SCH-to-degree by 4.2 but decreased time-to-degree by 0.1 years or 1.2 months.

The effect of dual-credit participation on student outcomes is more positive for White students, higher income students, and students with higher levels of academic preparation; the effect is negative in some cases for less advantaged groups. Our analysis indicated that dual-credit participation increased enrollment and completion primarily at four-year colleges for White students. For Black and Hispanic students, dual-credit participation increased enrollment at two-year colleges but did not meaningfully influence college completion rates. We also found that students with eighth grade standardized test scores that were one standard deviation above the mean in mathematics and reading benefited significantly more from dual-credit participation than did students with lower scores. Of particular concern, we found that, on average, the impact of dual-credit participation for students who were eligible for free or reduced-price lunch was negative for most outcomes. However, further analyses suggest that these patterns were likely due to the fact that free or reduced-price lunch eligible students were more likely than ineligible participants to have lower eighth-grade standardized test scores that hindered their success in dual-credit education courses.

Limitations

Analysis for Questions 1-2 Was Descriptive and Cannot Point to Causal Claims

First, it is important to reiterate that the analyses used to address questions 1-2 are descriptive in nature, and we cannot make any causal claims based on the results. In particular, our analysis of patterns in dual-credit participation, success, and delivery before and after the passage of HB 505 was descriptive in nature. Importantly, there may be other factors aside from HB 505 that drove the changes reported.

Limitations Related to Scope

Second, although our causal impact study provides strong evidence on the impact of dual-credit education on a wide range of academic outcomes, the study is limited in several ways. First, the scope of the study is limited to focus only on the impact of dual-credit courses that were delivered prior to HB 505 in a traditional high school setting. As such, we are unable to speak to the impact of ECHSs or the causal impact of dual credit since HB 505. We decided to focus on dual-credit programs delivered to students within a traditional high school setting, as opposed to an ECHS, because the vast majority of dual-credit participants access dual credit through such settings and less was known about the impact of such models where access and supports are less regulated. Finally, because HB 505 was just passed in 2015, an insufficient number of junior cohorts experienced dual credit since HB 505 to observe postsecondary outcomes.

Estimates of the Impact of Dual Credit may Overstate the True Impact

Third, there are a number of ways in which the assumptions underlying the causal interpretation of our model may not hold. As described previously and in detail in the Appendix A, our econometric model essentially compares two students with similar characteristics, one who participated in dual credit because a large share of other students in his junior cohort did so and another who did not participate because a smaller share of students in his junior cohort did so. The primary assumption underlying this approach is that changes in unobservable factors that could influence student outcomes are not directly correlated with the expansion of dual-credit programs within high schools. There are a number of ways this assumption may be violated. Most factors would cause our estimates to overstate the true impact of dual credit.

For example, if high schools that expand dual credit faster than others do so because more of their students desire to go to college, then our estimates would overstate the impact of dual credit. This is because our estimates would also reflect the change in student college-going culture. On the other hand, one of the primary mechanisms through which dual credit is

hypothesized to operate is through its direct influence on the college-going culture within high schools. If the expansion of dual credit itself caused the change in underlying college expectations among students, we would want to include this effect within our estimates. We conducted a number of sensitivity analyses to assess the extent to which peer effects of this nature may affect our estimates. In particular, we reran our model using a measure of the extent of implementation of dual credit in the high school during the previous cohort as the instrument, and the results were qualitatively similar to those we emphasize in the report.

More generally, if high schools also changed other college-related policies or practices while expanding dual credit enrollment, then it would be impossible for us to separate these effects from the influence of dual credit. However, most policies or practices that schools would implement while expanding dual are likely to promote higher college enrollment, which would cause our estimates to overstate the true effect of dual-credit participation. For example, if high schools expanded dual-credit programs at the same time as they improved advising and support services, or expanded college access campaigns, then our estimates would include the influence of such factors causing us to overstate the impact of dual credit. Note that we are only concerned about changes in school policies and practices that coincide with the expansion of dual credit. Any permanent school-level factors, preferences or policies promoting higher college enrollment rates would be accounted for with the school fixed effects that we include in the model.

Similarly, if parents were to systematically seek out schools that offered dual-credit programs so that their kids could participate, then our estimates would also likely be upwardly biased. This is because these parents are likely to be more educated and motivated to take actions to improve their kids' success, both factors that would likely contribute to positive postsecondary outcomes for their kids.

In short, there are a number of factors that could cause us to overstate the true effect of dual credit. However, we are challenged to identify factors that would cause our estimates to understate the true impact of dual credit.

A crucial question is whether there could be any downward bias to our estimates of the impact of dual credit. One possibility is that attenuation bias caused by any measurement error in our measure of dual-credit participation could be exacerbated by controlling for school fixed-effects. We do not believe this factor to be a major concern because we derive our measure of dual-credit participation using state administrative records. However, it could be possible that during

the implementation of dual-credit programs, schools had trouble coding this information accurately.

Another possibility that would lead to downward bias in our estimates of the impact of dual credit would be if high schools expanded dual-credit opportunities because they were on a downward trajectory and wanted to "to turn things around." This is because our estimates would be capturing the factors underlying the general downturn. This seems implausible, as it is unclear why schools would respond to downward trajectories in student test scores or to enrollment declines by offering DC courses. To assess this concern, we ran our instrumental variables model using average student characteristics at the high school such as race/ethnicity, free or reduced-price lunch eligibility and eighth grade standardized test scores as the outcome. These models did not show a consistent pattern of a change in high school composition as high schools expanded dual-credit programs.

In short, there are a number of plausible factors that could cause us to overstate the true effect of dual credit. The factors that could cause us to understate the true effect of dual credit are less plausible and are generally not borne out in the data. Estimates from descriptive studies would also likely overstate the impact of dual credit due to failure to adequately control for differences in student characteristic. Since our estimates for the impact of dual credit are smaller than what have been reported in past descriptive studies, we believe that our estimates are more reasonable and closer to the truth than any that have been reported in the past.

We Estimate the Local Average Treatment Effect

Finally, it is important to note that the IV model we used does not isolate the causal impact of dual credit for all students, but rather a weighted effect where the students who are most responsive to the instrument are weighted the most; this is what economists refer to as the local average treatment effect (LATE). In our case, this means that we identify the effect of dual credit for students who would be most likely to switch from a nonparticipant to a dual-credit participant because they moved from a school with a larger share of dual-credit participants to one with a smaller share.

Chapter 2. Dual-Credit Advising Practices and Models

As states, districts, and education institutions look for ways to improve the effectiveness of dual-credit education to boost students' college access and completion, the dual-credit advising process is an important consideration. College advisors and high school counselors may serve as the primary source of information about dual-credit education for students and families as they navigate the complexities of determining the best path forward to postsecondary attainment and career success. The 2015 passage of HB 505 in Texas, which significantly lowered restrictions on institutions delivering dual-credit courses, has heightened the potentially important role of advisors and counselors in promoting student success in dual-credit pathways to postsecondary degree completion. High-quality guidance can help reduce the number of excess semester credit hours dual-credit students obtain, ensure course credits earned through dual credit transfer toward the requirements of a particular major or certificate, and prepare students for the expectations and rigors of college-level classrooms and coursework. A 2012 study of dual-credit and high school advising on student persistence in college suggests there are two critical components to advising. These include: strong advisor support and finding the balance between supporting students and giving students the tools to problem solve and advocate for themselves during the advising process (Raia-Taylor, 2012).

In this chapter, we present the findings from a set of qualitative interviews we conducted with a sample of high school counselors and college advisors involved in dual-credit student advising. We conducted these interviews with the goals of better understanding advising within the current environment of dual-credit education in Texas, and offering practical, research-based suggestions on how to improve dual-credit advising processes and practices.

Background and Policy Context

The ways in which dual-credit education is operationalized across the state of Texas varies, largely shaped by are shaped by the different district policies, dual-credit partnership agreements between colleges and high schools, dual-credit course delivery modes and range of course offerings, distance between the colleges and their high school partners, financial supports for dual-credit education, school philosophies, and student demographics This wide variation in dual-credit education contexts and approaches affects the advising process at the local level, including the extent to which counselors and advisors target and encourage certain students to pursue dual-credit education and how they guide student course taking.

The variation in approaches that are used to deliver dual-credit coursework and advise students into dual-credit course options raises questions about how differences in the roles advisors on

the college and high school sides play affect the quality of advising in dual-credit programs. Although college advisors and high school counselors carry out their responsibilities within the requirements and guidelines of their particular dual-credit partnership agreement, the manner with which these individuals interpret local dual-credit policies and implement their practices will inevitably depend on their familiarity with the dual-credit model and their understanding of the benefits and potential pitfalls for dual-credit students in taking certain courses or a certain number of courses. Dual-credit advising also contains a degree of subjectivity that can affect student participation, persistence, and outcomes, especially if counselors and advisors are carrying out their responsibilities with limited time, resources, or information.

This component of our Phase II study aims to deepen understanding about the dual-credit advising process and seeks to build on the results of Phase I, which raised some important issues and questions about the advising students receive. The Phase I study reported that, according to dual-credit administrators at the community college level, the extent to which college advisors provided specialized and individualized guidance to students and families hinged on available resources. In cases of limited resources, high school counselors took on a more prominent advising role. For some dual-credit administrators, this was a concern because they perceived high school counselors as having limited knowledge about the rigor and transferability of college-level courses. In addition, concerns were raised among dual-credit administrators about high school students taking dual-credit courses when they had not yet selected a major and the emotional and academic preparation of high school students to succeed in college-level coursework (Miller et al., 2017). The emergence of these findings led to this study's focus on the following RQs:

RQ 1 How are high school students advised into dual-credit education programs and courses?

RQ 2 How might different advising practices or models contribute to disparities in dual-credit education participation?

RQ 3 What are some promising approaches to improve dual-credit advising to reduce the average number of semester credit hours students who took dual-credit in high school ultimately earn toward a college degree?

Framed by the theories of policy sociology (Gerwitz & Cribb, 2002), public management (Gray & Jenkins, 2006), and sensemaking (Spillane, Reiser, & Reimer, 2002), this component of the study examines how the scope, depth, and quality of advising of dual-credit students are influenced by macro- and micro-level system pressures; resource constraints; governance structures; and advisors' and counselors' experiences and perspectives. The interviews were also used to

explore the extent to which advising processes may influence student access to and participation in dual-credit education.

The findings presented in this chapter contribute to a stronger understanding of dual-credit advising policies and practices in Texas to help identify where improvements in advising can be made to help reduce excess semester credit hours, ensure credit transfer to degree, and promote equitable student access to and successful outcomes in dual-credit education.

Data Collection and Analysis

Data Sources and Collection Activities

The research team conducted semistructured telephone interviews with college advisors and high school counselors across the state of Texas who were involved in dual-credit student advising. For this component of the study, we included counselors and advisors in ECHS partnerships to gain a deeper understanding of the full range of advising approaches and practices to which students are exposed and to explore any differences in student advising between ECHSs and other dual-credit education partnerships that could inform efforts to employ promising practices more consistently across the state. Prior to each scheduled interview, the respondents completed an online questionnaire, which gathered basic contextual information about their advising roles, the students they served and their dual-credit partnership. (See Appendix B for the preinterview questionnaire and interview protocols.) We used these data to tailor and streamline the interview protocol and ask probing questions regarding their practices and the factors that affected how they carried out their responsibilities.

The interviews took place between November 2017 and February 2018 and were used to collect data on high school counselors' and college advisors' respective roles and responsibilities in the dual-credit advising process, the factors they considered in advising students into dual-credit education and into specific dual-credit courses, how they shared information with students and families, and how they coordinated advising-related activities with their dual-credit partners. In addition, the interviews asked college advisors and high school counselors to describe the challenges they experienced in advising dual-credit students and identify the supports they believed would help them overcome these challenges. The interviews were audio recorded and transcribed to ensure accuracy and completeness of data.

Sample

The research team selected a purposeful sample of 52 IHEs and 50 high schools with dual-credit partnerships to ensure the sample captured the variation of dual-credit delivery models represented in the state. The criteria for selection included the following:

- Type of IHE partner (two-year versus four-year institution)
- Size of the dual-credit education programs—operationalized as the number of partnering districts and schools and the number of dual-credit SCHs delivered, wherein the number of SCHs is defined as the number of contact hours per week delivered for a given course over a semester
- Type of dual-credit education delivered (academic versus CTE)
- Approach to delivering dual-credit courses (ECHS designation)
- Geographic region in the state
- Location of partnering high school (rural versus urban)
- Demographic characteristics of student population served (including socioeconomic status of students and percentage students of color)

Our final interview sample included counselors and advisors from 50 high schools and 52 IHEs. The characteristics of the final sample are provided in Appendix C.

Analytic Procedures

The analytic team developed a codebook and coded the transcribed interview data using NVivo 11 Plus, a qualitative data analysis software. The codebook development entailed two major steps: (1) we first established a preliminary set of codes, based on our key constructs of interest and associated questions in the preinterview form and interview protocol (e.g., roles and responsibilities, targeted students, coordination between partners); (2) we used this preliminary set of codes to code a sample of the interview transcripts, using both inductive and deductive coding methods to generate a final set of codes. The final codebook is presented in Appendix D. The final set of codes were structured so that analysts could apply more than one code to the same interview passage as applicable and to facilitate within and cross-case analyses. Throughout the analytic process, the team engaged in regular communications throughout the coding process to ensure consistent application of the coding structure, strategies, and rules for coding the data. Major emergent patterns and themes were also shared and discussed to confirm a shared understanding and interpretation of the coded data.

The team's approach to analysis was purposefully integrated, leveraging the data from both the set of college advisor interviews and the set of high school counselor interviews to enhance our understanding of dual-credit advising as a whole and to detect patterns among colleges and high schools with different characteristics. Specifically, we undertook iterative thematic coding of each major topic and interview question to surface recurring patterns and common themes (Maxwell, 2013; Merriam, 1998) across all college advisor and high school counselor respondents to assess the prevalence of practices across sites and to identify examples of advising practices and models that may be of interest to policymakers, school leaders, and other educators. This same coding approach was used to conduct subgroup analyses to explore advising practices overall and differences in advising approaches and experiences between high school counselors and college advisors and to explore any differences in advising specific to partnerships with an ECHS partner, with CTE making up 75% or more SCH delivered, and those serving rural student populations.

These subgroup analyses were of interest based on the findings that emerged from the Phase I study (Miller et al., 2017) and other scholarly literature suggesting that the types of students targeted for dual-credit education, the factors that are considered when counseling students into dual-credit education programs and courses, and the challenges and supports needed to improve dual-credit student advising may be affected by these factors.

Limitations

Readers should note some limits to the interpretation and generalizability of the interview data because the study sample did not fully reflect the total population of dual-credit partnerships, and the large number of college advisors and high school counselors involved in dual-credit student advising. The data obtained through these interviews also are limited to the recall and perceptions of the individual respondents at the time of the interview. Thus, the full range of advising practices, processes, procedures, and experiences may not have been captured. However, it is expected that these limitations had a negligible effect on the findings.

Organization of Chapter

The remainder of this chapter is organized around key findings that address the three primary RQs. We first report on the students targeted for dual-credit education, then the roles and responsibilities of high school counselors and college advisors in the advising process and the extent to which and how advising activities were coordinated between partners. We next discuss the dual-credit course selection process, including how students were counseled into specific dual-credit courses and the latitude students are afforded in the selection process. The

chapter concludes with a discussion of the reported challenges and supports needed to improve student advising, particularly related to reducing risks of excess credit, increasing the likelihood of dual-credit course transfer to a specific major and postsecondary degree, and ensuring greater equity in dual-credit participation and outcomes for dual-credit students.

Findings

Students Targeted for Dual-Credit Education

The extent to which high school counselors and college advisors actively targeted students for dual-credit education varied based on district policies and school philosophies about which students could benefit from and succeed in dual-credit courses.

All respondents indicated that they targeted students for dual-credit programs based on district policies for dual credit and the MOUs that were in place with their partners. Within these parameters, there was some variation in the extent to which high school counselors and advisors actively recruited or encouraged certain types of students to apply. About three-quarters of the respondents reported that their partnerships encouraged all students to participate in dual-credit education while close to one quarter reported partnerships that were more selective, targeting only those students who were excelling in their high school classes and demonstrating high levels of emotional maturity. Many of the partnerships, outside of the ECHS partnerships, restricted dual-credit education to juniors and seniors, using grade level as a sort of proxy for ensuring students were academically prepared and mature enough for the dual-credit class environment.

With respect to counselor's and advisor's direct involvement in selecting students for dual-credit, nearly half of the respondents reported that they monitored student participation and their eligibility for dual-credit programs but were not technically involved in "selecting" students. Rather, students self-selected into dual credit if they were interested and met the test score requirements on the TSIA or additional criteria. These counselors described their role in the selection process as largely telling [students] whether they can or cannot take it based on their TSI results or their ACT or SAT exemption. We don't tell who can and who can't. We will make the presentation to an entire classroom and then the only thing that we say is, "Yes, you can take it based on your academic TSI test" or "No, you can't because you're not qualified."

Although many other high school counselors in the sample indicated that they played some role in selecting students into dual-credit programs, most still described their involvement as fairly minor. For example, some respondents said their schools maintained an "an open-door policy"

but that they were required to sign off and officially approve students for participation after reviewing evidence of their readiness for dual credit.

This finding is consistent with other studies of dual-credit student advising showing that students were not specifically selected for dual-credit programs, but primarily sought out dual-credit courses on their own initiative, with the college readiness placement test serving as the gatekeeper to participation (Osumi, 2010; Piontek, Kannapel, & Stewart, 2016). This finding is also consistent with another study reporting that more than 70% of one Southeast Texas high school's dual-credit students named themselves as their greatest influence in deciding to take a dual-credit class. Just 5% of students said their high school counselor had the greatest influence on their decision to enroll in a dual-credit course (Ozmun, 2013).

Dual-credit education outreach sessions and course offerings were designed accordingly.

Close to one-quarter of the respondents, however, described their dual-credit programs as more selective in their approach student selection. Among these sites, academic performance and student discipline, responsibility, time management, and emotional maturity were emphasized during dual-credit information sessions and during more individual counseling sessions. Several college advisors described using the information sessions with students and families to communicate what types of students are good candidates for dual-credit as an indirect way of either encouraging or cautioning against certain students to apply. As one advisor reported, "We try to be very frank with [the students] upfront and…we try to make sure the parents have information as well to understand that dual credit may not be the perfect choice for every student…they need to be able to operate on their own in a self-motivated way especially in the online courses." The high school counselors in more selective dual-credit settings echoed this sentiment and reported having candid conversations with parents and students about their dual-credit prospects and potential risks. When asked about whether there were any students she advised against taking dual credit, one counselor noted:

> *I wouldn't say, "advised against it," but we have long talks with them and their parents, students who have poor study skills or have low academic grades, especially in the subject that they're wanting to take the course in…. I tell them, I say, "Dual-credit can be doubly good or doubly bad." I say, "If you don't pass it, then you don't get credit in high school and you also don't get credit in college, and you have an F on the transcript.*

Another explained,

> *We've got groups of students who are not academically successful…we don't want them taking dual-credit classes if they're going to end up failing or dropping or getting a W on*

> *their transcript or even getting a D. We don't want them to do it just to do it. We want to make sure they can be successful and then it's going to pay off in the end.*

In most cases, these schools targeted and encouraged the same students for dual credit as for AP and IB programs, leaving it up to the student and their families to determine if they wanted to enroll in both or one or the other. In a few cases, however, high school counselors indicated targeting the highest performing students (those in the top 10%) for AP versus dual credit because they perceived the rigor of AP courses as higher and then targeting those performing in the top 20% to 25% for dual credit.

Some schools, particularly those serving disadvantaged populations, had a clear focus on access and encouraging all students to participate in dual-credit education.

The ECHS schools that, by design, target all their students (Grades 9–12) for dual-credit education, followed this approach, but so did close to one quarter of the other high schools in the sample. Many of these other high schools served first-generation or low-income students, and counselors emphasized their school's commitment to developing students' awareness of the postsecondary options available to them and to fostering a college-going culture. As one high school counselor reported, "We try to encourage our kids to reach their highest potential and realize that maybe we see something more in them than they might see in themselves and so we talk to all of our kids about dual-credit classes and we differentiate between those classes and how it'll benefit them and how it won't." Similarly, another stated, "We really [encourage] our dual-credit programs…to open those doors and [help students] realize that, 'I can go to college. I am smart enough.'" As a final example, one high school counselor described how the only students they really went out of their way to encourage into dual-credit programs were the students on free and reduced-price lunch because these were the students that often weren't as aware of the dual-credit opportunity as other students and/or as likely to perceive dual-credit as an option even if they were strong candidates.

Similarly, a few high school counselors indicated that, based on their prior observations and experiences in advising students, they believed all students have the potential to succeed in dual-credit courses. One explained,

> *my five years as a dual-credit advisor that students come whether they have physical disabilities, whether they have mental disabilities, whether they have straight As or they have a 2.2 GPA. I found that any type of these students can be successful in a college class pending having the desire and the motivation to do so…. I've also seen students*

> *who with their 3.5 GPA and have been in pre-A.P. classes all their lives who are right now dropping their college course because they were not successful.*

The counselor from another high school shared this sentiment noting that students were not directly advised against dual-credit education because of the unpredictability of what types of students would be successful: "We have some students who are very immature or sheltered, and I have thought they're probably not going to do well, but then they really seem to enjoy the challenge or the different atmosphere, different teachers."

ECHS schools, rural schools, the schools with CTE dual-credit programs, or schools with a wider range of dual-credit courses beyond the core were also more likely encourage a greater variety of students to participate. In some cases, counselors perceived that any college course experience would benefit their students by allowing them to more deeply explore or progress in a certain field of interest or gain exposure to the college environment. One high school counselor indicated, for example, that she believed dual-credit welding and art classes could challenge students to meet the expectations of a college course and develop important skill sets that could benefit students in their future endeavors while providing students with opportunities to "express themselves in a little bit of a different way." This counselor went on to explain, "We think all kids are capable of that type of rigor and that type of level of thinking, even those that might take a little longer to get there."

Despite the variation in the extent to which certain types of students were actively targeted or encouraged to pursue dual-credit education opportunities, we found no evidence to suggest that implicit biases or discrimination in advising practices was leading to disparities in dual-credit student participation. District policies and school philosophies appeared to have the largest effect on which students were targeted and selected for dual-credit education.

Cost and extracurricular activities were most frequently reported barriers to student participation in dual credit.

High school counselors and college advisors most commonly reported that the TSIA, as the primary gatekeeper to dual-credit education, was the only major barrier to student participation in dual-credit programs. For the students to which dual-credit programs were targeted, however, most did not perceive significant barriers to access. Respondents attributed the lack of barriers to their school's open-door policy to dual-credit education; financial supports for students such as tuition waivers, discounts, or scholarships; and proactive efforts to encourage all students to participate in dual credit coupled with intervention and support services to prepare students for the rigor and expectations of dual-credit classes.

Approximately one quarter of respondents, however, did report that some of their qualified students were not able to participate in dual-credit education. The costs associated with taking dual-credit classes was mentioned most frequently, particularly by advisors and counselors serving rural communities where many of the students were economically disadvantaged. One high school counselor remarked, "The other problem is our district does not pay students or pay for students' dual-credit classes like a lot of them do around here. I believe that we have a lot of students that could take dual-credit and benefit from it, but they are unable to afford it."

Another commonly perceived barrier among these respondents was the number of other activities in which students were involved such as jobs, sports, performances, and honors societies that competed for their time. High school counselors described the difficulty some students had in fitting dual-credit courses into their daily schedules, with one counselor explaining, "Those kids are also your NHS [National Honor Society] kids, your kids that are involved in our National Technical Honor Society that are in band or cheer and now they're adding one more thing to their plate, which in turn affects their grades, which in turn – it's a cycle." One school had taken action to help remedy this type of barrier by establishing class periods during which students could work on their dual-credit coursework. According to the high school counselor, in past years the students had to complete their online dual-credit courses on their own time, but the new class periods gave them dedicated time during the school day to complete their work, and she had seen an increase in student participation.

Counselors working at ECHS high schools and a few of the counselors at other high schools also reported a more active advising role when students were not performing well in a course. ECHS schools commonly offered support systems on site, including college prep classes, study skills classes, tutoring, and some social-emotional supports into which counselors could direct struggling students. The high school counselors in other types of schools more frequently described advising students who were struggling in their dual-credit courses to access the supports and services available to them on the college campus. Although at least two of the non-ECHS high schools in the sample had taken pro-active measures on their side to help promote all of their students' success in dual-credit education. One of these schools had started a middle school bridge program that continued into the high school to prepare and support dual-credit students. Similarly, another high school counselor reported on a new school-based intervention that they counseled students into if they needed support with their dual-credit courses:

> *We've actually started something this spring, kind of a mentoring program with some of our weaker students that are not maybe making the grades that they should be and they're struggling in some classes and/or they're new to dual-credit and they're taking*

on a lot of classes all at once. We have a teacher assigned to maybe two students, and they check on them weekly, if not daily, and get to know them better, know what makes them tick, get to them on a personal level.

Roles of High School Counselors and College Advisors

The majority of high school guidance counselors played the primary role in advising dual-credit students, with one quarter sharing this responsibility with college advisors.

Overall, high school counselors played a vital role in coordinating dual-credit student registration, course scheduling, activities to build dual-credit awareness, and student participation. They were the central point of contact for enrolling students and served as the main liaison between the high school and the college. In addition, with few exceptions, high school counselors served as the primary advisors for dual-credit students, both with respect to selecting or determining student eligibility for dual-credit education and working with students to select dual-credit courses.

Nearly all of the college advisors reported relying on the high school counselors or administrators to identify the students for dual-credit participation per the partnership agreement and district policies. Rarely were they reported as being involved in the actual selection of students into dual-credit programs beyond confirming that students met the dual-credit college application requirements. As one high school counselor indicated, "We pretty much do the advising. Our college advisors are there to answer any questions that we may have…. They typically don't meet with the students face to face. We're that mid person." Similarly, a college advisor reported, "We rely very much on the school counselor to say, 'Yes, the student can be successful in this course,' because they know those kids much better than we do. It's the way that we operate. If the school says, 'Yes. We feel like they're mature and they can handle it. They're self-motivated. They can do this,' then we go ahead and put them in."

This overall reliance on high school counselors may be significant in its implications for ensuring high school counselors are armed with the knowledge and training they need to: assess the academic and emotional readiness of their high school students for college-level coursework, while still promoting equitable access to dual credit; and the have understanding of postsecondary degree programs and requirements to help ensure students are streamlining their postsecondary pathways and not taking on excess credit. Moreover, high school counselors are typically tasked with serving large numbers of students and not just dual-credit students. As will be discussed later in this chapter, high school counselors frequently reported

struggling to balance their dual-credit advising responsibilities and their other responsibilities, resulting in less one-on-one advising time with dual-credit students.

College advisors typically played a secondary or more indirect role in the advising process, serving as the key point of contact for high school counselors and delivering in-person dual-credit education information sessions to prospective students and their families, usually annually or biannually. They presented on the key features of the dual-credit program, student eligibility, course offerings, the registration process and required forms, and answered questions. Most college advisors indicated that they also used these sessions to emphasize the important differences in instructor expectations and rigor between dual-credit courses and traditional high school courses. For example, one advisor reported,

> *I go heavy on the idea of their schedules with college-level courses and the rigor and the expectations that the professors are going to have for them as college students. No missed days, no excused absences, that kind of thing. … We go over the importance of a syllabus and communicating with their professor.*

College advisors also consistently described being in regular contact with the high school counselors; so, even if they were not directly working with students, they were greatly involved in coordinating activities and sharing information with these individuals.

A few college advisors reported becoming more involved in selecting or advising students if they were "accelerated," pursuing CTE dual-credit programs, or if they were freshmen or sophomores.

College advisors became more directly involved in special circumstances, including in the case of "accelerated students" or advising outside of the core, CTE dual-credit programs, freshmen and sophomores, and poor performance. When a student was "accelerated," or on track to earn an associate's degree at the same time as their high school diploma, college advisors reported playing a larger role in advising. In such cases, the college advisor would typically meet individually with the student to make sure they enrolled in the courses they needed to complete their degree, while the high school counselor would continue to ensure students were enrolling in courses that would satisfy high school graduation requirements. Similarly, some college advisors noted that they were not involved in advising students unless students were interested in courses outside of the core. One of the partnerships in the sample, for example, required that students looking outside of the core participate in an advising session with a college advisor.

As another example, a college advisor talked about how she was not at all involved in the advising process for students pursuing the academic dual-credit program because the courses were limited to the academic core, but much more engaged in the CTE dual-credit advising because of how customized those programs are in terms of coursework. She reported that the high school counselor "gains their interest in the field, but I advise on what the next courses to take and where they are in their level of certification because with each course and each program, it's more specialized… I work with her and the students individually to say, 'These are the courses you need here, and this is what you'll accomplish with that in this certification.'" Likewise, another college advisor indicated that she was more involved in advising for CTE students stating,

> *It's really only the workforce students that we help, and by that I just do some probing questions. I ask them what their career goals are, I ask them why they're thinking that dual-credit is a good option for them, just trying to get to the reason behind why they came to see me or why they told their counselor they were interested in talking about dual-credit.*

Others mentioned that they only became involved in the selection of students if they were freshmen or sophomores, largely to help ensure the students were academically and socially prepared to meet the demands and expectations of college-level course work. As one of these advisors explained:

> *For [ninth and] 10th graders who are trying to enter dual-credit…. We do have a process in place where I do individual assessment of their attendance records or discipline records, their TSI scores, their high school transcripts, letters of recommendation to let them into the program. Juniors and seniors, they're just meeting the general admission requirements for the college and they come in, but for our freshmen and sophomores, there is a more hands-on direct advising experience.*

College advisors also described becoming more directly involved in the advising process when concerns arose about a student's class attendance or performance. Although, even in these cases, their involvement remained primarily with the high school counselor. Typically, they reported the concerns to the high school counselor who then took the lead on intervening with the student.

About one quarter of the college advisors and high school counselors described more of a shared responsibility in advising, with both parties equally involved in the process.

In these cases, both the college advisors and high school counselors had direct contact with students or were more actively engaged in regular communications to make decisions about how to guide students' dual-credit course selections. One of the high school counselors describing the advising process as "shared" stated,

> *[College advisors] meet with us twice a year…I [first] meet with kids and advise them based on what pathway that they're on [and] what class they should take. Then [the students] meet with a [college] advisor as well, and the [advisors] will either agree with me or they'd recommend them taking something else based on where they want to go to school…and what they want to study.*

In these cases of shared responsibility for advising, the college and high school were often located close to one another, allowing college advisors more frequent access to students and direct involvement. One of the high school counselors in this type of situation described how their partner college was located just two blocks from the high school and the college advisor had two offices—one at the college and one in the high school. This arrangement led to the college advisor and high school counselor working in tandem to counsel students into dual-credit and dual-credit courses. The high school counselor explained, "[she] and I work very closely…she assists in all of the advising so [she] and I will meet with [students] together so they hear the same thing from both of us." Similarly, another partnership had established an advising structure where the college advisors had a dedicated high school counselor contact for CTE dual-credit and one for academic dual-credit. The CTE counselor's office was on the college campus, which "offers a lot of convenience," according to the college advisor; and on the academic side, the college advisor reported having face-to-face meetings with the high school counselor at least once or more a semester. Although the high school counselors still took the lead on student recruitment, the college advisor indicated working very closely with the school to provide students with the information they needed and that they maintained an open-door policy with dual-credit students. High school counselors referred students to the college advisors if there were any questions or parent concerns related to a student's participation in dual-credit programs.

This more infrequent shared approach to advising dual-credit students may warrant further exploration to determine the potential value add of having the college and high school perspectives guide student selection and course taking.

Coordination of Advising Activities

Overall, high school counselors and college advisors described close working relationships, most commonly to coordinate school visits and dual-credit information sessions, registering students, and course scheduling.

All of the high school counselors and college advisors in the study described coordinating dual-credit activities with their partners. They primarily coordinated efforts related to students' application materials, registration, course scheduling, and transcripts and grades. They also reported coordinating joint dual-credit information sessions for students and families to share both perspectives on the dual-credit education opportunities and expectations.

Many counselors and advisors also reported that they worked with each other to develop materials to help counsel students into certain courses or to help monitor and track students' progress toward meeting their high school graduation requirements or an associate's degree. For example, high school counselors typically developed a course crosswalk to share with advisors so they could see how the dual-credit courses mapped to high school graduation requirements. Likewise, college advisors reported providing high school counselors with their academic catalog "so that they're familiar with any changes in our degree requirements and they can also look at course descriptions to determine if they can crosswalk certain classes. We also sometimes provide them with the syllabus for different courses if they're needing to compare student learning outcomes again to determine if they can crosswalk classes."

In a few cases, advisors and counselors worked more closely together to decide which classes would be offered as dual-credit each year. For example, one high school counselor described being in the process of planning with the college advisor for the following year to put together the dual-credit course guidebook and a "choice sheet" for students that would outline the classes available for the fall semester.

Nearly all advisors and counselors reported being in regular, if not constant, e-mail or phone communication as advising questions, concerns, or other issues arose. They described open lines of communication to check in on how students were doing in dual-credit courses, ask questions about credit-transfer or course credit toward degree, relay questions from parents, provide updates on new initiatives or policies, or to share scholarship and financial support opportunities for dual-credit students. Some partners held more formal check-in meetings throughout the year to review procedures and troubleshoot any concerns. One college advisor reported holding counselor meetings with the high school every fall and spring semester,

> *where we'll go over all of the general housekeeping items, any concerns that are coming up. We do this in group sessions and then I am out visiting face-to-face, at least a few times a semester, to talk to them about different things, pass along information to see what their concerns are and assist them with any questions, and then we provide support and coordination via phone and e-mail, sometimes on a daily basis.*

Another counselor described visiting the high school at least two or three times a semester to have direct contact with the dual-credit students and meet in person with the counselors. This counselor stated that these visits, as well as other activities such as college fairs, were planned and coordinated in close collaboration with the high school counselor.

Close proximity to one's partner was perceived as fostering effective coordination.

Although being far away from one's partner was not reported as a major barrier to coordination, the college advisors and high school counselors that were in close proximity to one another emphasized the benefits of the face-to-face interactions they were afforded. As one college advisor stated, "Conversations and e-mails are great, but when you're able to sit down with somebody and just deepen what's already there, there's benefits to that." Many others talked about how valuable it was for the partners to be "a familiar face" among students and for both sides to have a firsthand knowledge of their respective campus cultures, students, staff, and procedures. The opportunity for students to visit and spend time on the college campus was also seen as helping ease students' transition into dual credit, including their ability to adapt to the college environment and raise their comfort level with being on a college campus.

Course-Taking Considerations

Students' postsecondary plans and likelihood of credit transfer were most commonly considered in advising students into dual-credit courses; high school counselors also frequently reported considering students' grade level and high school graduation requirements.

Postsecondary plans and credit transfer. Regardless of the extent of their involvement in advising students, nearly all of the counselors and advisors emphasized the importance of students' postsecondary plans, including their planned major or desired CTE-degree certificate and where they were interested in attending college in guiding dual-credit course taking decisions. Respondents described how having this information allowed them to better counsel students into taking courses that would transfer to a specific degree plan, whether they would be seeking an associate's degree or a four-year degree. Many high school counselors and

advisors expressed concern that if students were undecided in their major or uncertain about their post-high school plans, they would be at risk of taking and spending money on courses that would not transfer to a specific degree or college, particularly if they elected to attend an out-of-state school or highly selective university.

Indeed, credit transfer was reported as a major advising consideration by the majority of high counselors and college advisors and many reported sharing resources with students about credit transfer; however, for the most part students were strongly counseled to conduct their own research on credit transfer. For example, as one counselor described:

> *We don't specifically review [credit transfer] ourselves. It's indicated that the students need a little bit of legwork to go along with that. We talk about certain courses and how they transfer. As an example, political science, health, those can transfer to different institutions within the state of Texas. We talk about the common core's numbering system to look at how classes are going to transfer. Then we talk about instances where they might have to repeat a course depending on the institution that they transfer to and what their major is going to be within that.*

High school counselors and college advisors taking this approach reported strongly advising students and their parents to call colleges directly to find out if a certain course would transfer and to review credit transfer policies on college websites. A small number of high school counselors and advisors, however, took a more active role in confirming credit-transfer information for students to guide students toward specific courses. One high school had developed templates to map certain courses onto specific majors and degrees at some colleges. Similarly, another respondent described how the counselors would pull the transfer sheets directly off college websites for students to "make sure that any class that they're interested in is something that will be, one, be part of their degree plan and two, be something that's commonly transferable." One high school used a specific program called Naviance[9] with students. The program offers an online career interest survey and, according to the high school counselor, "they match that career interest to a college major at a particular university, and this program automatically pulls up a degree plan, courses that they would need to take to graduate with that degree…. We can match their dual-credit to those courses." At the same time, this counselor still emphasized, "I'm very careful to tell them that until they meet with their college advisor at that freshmen orientation, you really don't know exactly what is going to be accepted and what's not."

[9] https://www.naviance.com/

High school graduation requirements. High school counselors also frequently reported considering the high graduation program of study and degree requirements when advising students into dual-credit courses. They indicated that a critical part of their role was ensuring that students were enrolling in dual-credit courses that were crosswalked to high school diploma requirements or their selected high school endorsement area. As one high school counselor explained, "If the student is a sophomore, for example, U.S. history is part of the 10th grade curriculum in the high school, so what we would try to do is swap out what they would take at the high school level for the equivalent dual-credit class." Some college advisors also reported considering high school graduation requirements, but largely relied on the high school counselors to monitor students' progress in satisfying those requirements.

Counselors working in high schools that offered a wider variety of course options, including CTE dual credit in addition to academic dual credit, described a higher level of involvement in counseling students into certain courses. In these cases, counselors described meeting individually with students to help them decide which courses bet fit their interests, college, and career aspirations and to counsel them into courses that mapped to earning an associate's degree or a certificate in a certain field. As one counselor put it, "We don't mandate just a menu of classes, complete menu for everyone. We individualize it. So students sign up for classes then they have a three-to-four-week where we're actually making class option changes, and we discuss with them if they have questions about why they should choose dual-credit over a regular AP class or vice versa."

Grade level. Counselors and advisors frequently indicated that students' grade level either dictated or strongly informed which courses they guided students into. In many cases, grade was used as a sort of proxy for determining students' academic readiness for certain courses, their maturity or preparation for the rigors and expectations of particular dual-credit courses. Freshmen and sophomores typically had less choice than juniors and seniors (if they were allowed to participate in dual-credit courses at all per district policy) and in some cases no choice. For example, one high school counselor explained how very little advising occurred for ninth and 10th graders because they were in courses "that are basically picked for them." Freshmen, for example, were automatically placed into a Learning Frameworks course, according to many counselors to help prepare them for the more rigorous dual-credit courses they would experience in later grades. Others described purposefully steering students away from certain classes they believed were more appropriate for juniors and seniors. As one respondent stated, "I would never let a freshman take an economics course or a psychology course. I probably wouldn't even let a sophomore take a psychology course just because of the demand, and the rigor, and just the content of the subject." Another counselor indicated, "We want to make sure that we get the students in the correct courses and if they can handle the course load along with being a high

school student and whatever else activities they're enrolled in. We generally give them the easier classes at first semester…and see how they do with it. That way, we can always [recover] their credit if something were to happen." Likewise, a few respondents indicated that they guide freshmen away from taking any online course offerings because of the maturity level they believed was necessary for success in these types of learning environments.

One counselor working with CTE dual-credit students also indicated new CTE dual-credit students (typically sophomores) were counseled into an exploratory class designed to provide an overview of the four CTE dual-credit programs available to students. According to the counselor, they recently switched to this approach because they found the vast majority of their students were selecting welding as a default, without having a full understanding of the work and career opportunities of the other fields, such as air conditioning and electrical and machine maintenance. Another counselor reported counseling younger students into the general core classes because "they aren't ready to declare a major" and to start mapping their dual-credit courses to a specific degree track.

Indeed, many counselors indicated that because juniors and seniors were typically more certain of their postsecondary plans, they provided more targeted counseling. As one counselor described, "grade level plays a big role, not so much with their first 6 to 12 hours. Because a lot of students, they're going to take the first two history and the first two English, which is pretty much basic for everybody…But once we get past 9 to 12 hours, again then we're going to start being a little more careful because we may do government, [but] not do Texas government [if] they're going out of state." Others noted that they advised juniors and seniors differently than younger students because of the greater number of courses available to juniors and seniors and, thus, the greater risk for excess credit. In addition, counselors and advisors indicated that less frequently considered factors were students' academic performance in prior dual-credit courses and course load and extracurricular activities.

Students' academic performance in previous dual-credit courses was raised as a key consideration among close to half of the high school counselors and a small number of college advisors. Some partnerships had stipulations in place that would not allow dual-credit students to take certain classes or continue in dual-credit programs if they were performing poorly. For example, one partnership did not let students sign up for another course in a specific discipline if they did not make a C or higher in one of the discipline-specific classes. Although students could try to take the course again, the counselor indicated students were often advised against doing so because they saw it as a risk to earning credit and to graduation. Similarly, a college advisor for another partnership reported that, for struggling students, "We might have a

conversation with them about maybe transitioning to more of a general studies track where they would still complete the associate's degree and the core curriculum, but maybe not necessarily that life science or mathematics major with us."

Advising Challenges

High school counselors and college advisors described challenges related to high school students' academic and emotional readiness for dual-credit education, the latitude given to students in dual-credit course selection, and the limited time they had to fulfill all of their dual-credit advising responsibilities.

High school counselors and college advisors reported a wide variety of challenges they experienced in advising students into dual-credit education or into specific dual-credit courses, describing some as relatively minor and others as more problematic. Addressing students' academic and emotional readiness for dual-credit education was the most frequently shared challenge, particularly among high school counselors. Approximately half of the high school counselors and about one third of the college advisors reported this challenge, but experienced it in different ways. Some, for example, experienced this type of challenge primarily during the registration process. Counselors and advisors described having to constantly remind students and parents to complete and submit their dual-credit paperwork in time and attributed this challenge with parents and students failing to understand the more rigid structure and requirements of college compared with high school. Or, in some cases, high school counselors talked about having to do the work for the students, which they perceived as harming the student in the long run. As one counselor noted,

> *It places a lot of the responsibility off of the students and puts it back on me. I think the students lose those—they lose that experience of their college because it's still all being done for them just like we do for high school…they're missing out on that college experience of you have a deadline, you have to get in there and choose your class, and get yourself registered for it.*

Many others reported that it was difficult to effectively communicate to parents and students the importance of emotional maturity and the ability of students to responsibly conduct themselves in college classrooms, meet instructor expectations for academic performance and engagement, and responsibly manage interactions and communications with the instructor. This finding is consistent with the results of the previous Phase I study of dual-credit education in Texas (Miller et al., 2017), which also highlighted some concerns among community college respondents about the undue pressures placed on students to enroll in dual credit even if it

might not be for the best for the student, especially for students who may need time to further develop their sense of responsibility and maturity (Miller et al., 2017).

According to counselors and advisors, feeding into this challenge was the various factors that push students into dual-credit education even if it is not the best fit. These factors included parental pressure, the weighting of dual-credit courses with respect to class rank and GPA, and students' feeling compelled because their peers were enrolling. One college advisor noted, for example, "students get points toward their class ranking or they're distinguished being towards valedictorian, salutatorian by taking these dual-credit classes. The more they have, I guess the better the points are and so they're concerned with being top in their class." A high school counselor also reported,

> *I think that students and their parents are really very interested in dual credit. It's been sold to them as a cost-effective measure to help them pay for their college, but I don't think we spend enough time talking to them about the maturity that it requires, the attendance that it requires, how it can negatively affect their degree plan on the college level if they have too many hours.*

It is important to note, however, that as found in the Phase I study, the majority of the respondents in this study did not explicitly mention students' underpreparedness or immaturity as a challenge, suggesting that most high school counselors and college advisors believe that the majority of high school students participating in dual-credit programs are meeting college-level course expectations.

Nearly one quarter of both high school counselors and college advisors indicated that the sheer number of dual-credit courses available to their students to choose from challenged their abilities to guide students into efficient course-taking pathways. These counselors and advisors were working under partnerships that placed few limits on dual-credit course offerings and the number of courses students were allowed to take. These respondents suggested that this approach to dual credit compelled students to take as many dual-credit classes as available and were of interest, even if they were not likely to transfer to a specific degree. They reported instances where high schools wanted to offer more elective-type classes such as "two or three classes in mathematics or four classes of Spanish throughout the year because they have people on their campus that are eligible to teach those and like teaching them and so they offer them." One college advisor noted as another example,

> *[The high school] had a handful of students who finished their associate's degree at the same time they graduate from high school, and when you look at their degree plan and the course selections that they've taken, their electives are all over the place. It's an art*

appreciation, it's a music appreciation, it's a theatre class. They don't fit within a one-degree plan that a four-year institution would offer unless it is just a general studies degree. Those students pay college tuition, they went through the course, and wherever they're going to transfer to, their four-year institution is going to utilize some of those credits, but they're not going to be able to utilize all of those credits.

The third most frequently reported challenge, by approximately one quarter of high school counselors and college advisors each, was the lack of time to complete all of their responsibilities and provide the individualized counseling they felt was needed. Respondents cited various reasons for these time constraints, but frequently reported that the logistics of registering dual-credit students, monitoring and tracking student progress, and coordinating activities with their dual-credit partners were very time consuming. In some cases, counselors or advisors did not just focus on dual-credit students, so they had to balance their dual-credit advising with the other roles they played. Time was particularly problematic for counselors serving large numbers of students and in schools where the dual-credit student population had grown in recent years. As one high school counselor reported, "We've grown from seven dual-credit graduates to 90 last year. We forecast to go over 100 this year. I think as we grow, the resources that are available now, we may need to change because we're not advising 20 students in dual credit anymore. We're advising over 500 or close to it."

Other counselors serving large numbers of students frequently indicated that it was not possible to meet individually with all of the students interested in dual credit or taking dual-credit courses, although they perceived that students could benefit from more independent counseling sessions. This issue of time has been raised in previous research on dual-credit education and similarly found that high school counselors perceived the work of managing dual-credit programs, including the recruiting, advertising, communicating with postsecondary institutions, finding instructors, monitoring financial aid opportunities, and tracking grades, as a full-time job in itself (Piontek et al., 2016).

A couple of other challenges were raised by small numbers of high school counselors and college advisors, but these were typically described as relatively minor. Course scheduling and coordinating dual-credit courses with high schools' calendars was one. This reported challenge is consistent with the Phase I study finding that community college dual-credit coordinators encountered challenges related to the differences in the way colleges and high schools schedule courses and other logistics, such as bus schedules (Miller et al., 2017). In addition, the distance between the high school and college partner was raised as a minor challenge, most often when the high school partner was rural.

Suggestions to Improve Student Advising

According to respondents, greater clarity on credit-transfer policies, early advising, more college-advisor involvement, and robust training could improve student advising.

Greater clarity on credit transfer policies. Nearly half of the high school counselors and about one quarter of the college advisors sought more guidance and clarity on credit-transfer policies. Although these respondents reported having sources they could turn to for this information, primarily college websites and the Texas course numbering system, they would have preferred a more streamlined and uniform process for finding transfer policies, particularly transfer to a specific degree. Many reported that university websites were hard to navigate and sometimes not up to date. Others noted that while many of the dual-credit courses often transferred, they transferred only as electives and not to specific degree tracks, so more degree-specific crossover documents are needed. One high school counselor, for example, stated,

> *If I had, for every public college in Texas, a site where I could do and print off core curriculum, "Here are the courses you're going to take. If you're going to major in architecture, here's a plan. Here's your course descriptions and your plans." I want to be the one to help the student make a choice or give them the information, but finding it and getting it in their hands so that they can understand it and take their time with it is challenging.*

Many others reported wanting a similar sort of crossover document that would include information for specific majors and what they require. A potentially promising practice was described by one high school counselor who attended an event at the community college partner where a number of four-year universities were on-site to share information. Each university had its own station that students could visit and receive credit-transfer guide sheets for specific majors. A few college advisors also suggested that policies that required better alignment between the college and high school curriculum could lead to a greater likelihood of credit transfer and reduce the risk of excess credit.

Early advising. Approximately one quarter of high school counselors and college advisors each suggested a need to start advising students earlier about dual-credit education and dual-credit pathways into college. They indicated that students and their families would benefit from an introduction to dual-credit education options as early as sixth to eighth grade, depending on when students became eligible for dual-credit education in their districts. According to these counselors and advisors, earlier advising that includes career exploration would better prepare

students and families to make more strategic decisions about dual-credit education, including decisions about whether and when to pursue dual-credit education, and whether to take dual-credit or AP courses, depending on the student's maturity level, academic record, and postsecondary plans. This need to build career exploration into early advising practices was particularly emphasized among respondents. Although counselors and advisors noted that they did not want to "pigeon-hole" students into a particular major or degree path, they indicated it was important to "capture them earlier…and talk to them more about career and what their goals are after high school." As one college advisor that was supporting an initiative to promote earlier advising stated,

> *We're not trying to move the freshman and sophomore year of college in to the senior high school—we're not trying to shift college down a grade, if you will, but what we are trying to do is get the appropriate information to students earlier so that they can make more important decisions about the high school plan and what courses that they could—should take for dual-credit if that's what they want to do.*

One high school counselor described a potentially promising approach to supporting students' dual-credit decision making. The school required students to participate in a mentorship program at the end of their junior year and one at the beginning of their senior year, "so they get an opportunity to work with some person out in the community who is in the field that they are interested in looking into. So, they get some practical experience just to help them."

More college advisor involvement. Many respondents indicated an interest in having college advisors play a more direct role in the advising process, either to fill gaps in the counselors' knowledge about what courses would map to a specific degree or certificate or to bring the college-level presence and perspective to the conversation. One counselor described the value of having a college advisor speak directly to students saying, "[The students] hear us tell them the same thing over and over, year after year, but when another outside person comes in and sits with them from the university, it's very eye-opening for the students." Similarly, other respondents further indicated that having a college presence helps "put a face to the university," gives more weight to the guidance students receive and allows for more strategic and informed dual-credit advising. As one high school counselor noted when asked about suggestions for improving advising: "I would like to see more involvement from the college actually coming to our high school campus and sitting down with students and working with students independently…I've always felt like that role and that responsibility should be coming more from the community college."

The college advisors shared this sentiment, indicating that dual-credit student advising would be improved if they had opportunities to engage students in individualized advising sessions, or at least had more face time with groups of potential or admitted dual-credit students to share information and guidance form the college perspective. One advisor raised a related, but slightly different concern. She estimated that 90% of the advising responsibilities fell on the high school counselors and stated, "They're so overwhelmed just trying to do the high school portion, and adding [dual-credit] is pretty burdensome. We're really hoping to provide some extra support with our advisors so that that weight isn't completely on them." Similarly, the college advisor for another partnership reported that they were in the process of hiring a dual-credit pathways coordinator who would be more involved in directly advising students to improve their postsecondary pathways and success. She noted, "The whole point of this new position is to become much more intentional in our pre-advising, our working with the student as they make those decisions, and then the post-advising, to make sure that we get them to that next step in higher ed, whether it's community college or university."

In the absence of a dedicated college advisor on campus, counselors recommended mandatory sessions with college advisors at the college campus or by phone so students could hear from college advisors directly. For rural sites or partnerships where in-person, individualized counseling was not an option, one counselor suggested virtual advising sessions with the college advisors, particularly when students change their plans and need more individualized advising to reduce risks of excess credit and extra time to degree. Similarly, a college advisor suggested using ITV to conduct an orientation session for newly admitted dual-credit students,

> *just like we do our regular freshman coming in. I think that's probably something that's been lacking with all our partners…. These are actually full-fledged accepted South Plains College students, and they need that orientation. They need to know how we do everything in our departments, and what's expected of them as college students, and how you're successful on an online class.*

Another college advisor also emphasized that more formal orientation sessions for new dual-credit students would be a benefit, especially to stress with students that college advisors are available to them on the college campus and can be a service to them. Ideally, however, this advisor stated that she would prefer having multiple days per week at the high school campus to hold advising sessions with students because students had such limited time on the college campus outside of attending their classes.

Robust Training. Overall, college advisors and high school counselors praised the relationship they had with their partners and the extent to which they were able to seamlessly share

important information and get the answers they needed related to student participation in dual credit. However, some advisors and counselors mentioned that they felt that they could better coordinate advising activities with their partners if there was greater clarity about their respective roles and more targeted training for dual-credit, including potentially joint trainings for high school counselors and college advisors to confirm how they will work together. As one college advisor explained, "There's just so many people involved that sometimes things—one person thinks one person's handling something and one person thinks it's somebody else." Similarly, other advisors talked about how more role clarity and training on how to effectively advise dual-credit students would help streamline the coordination of activities and also better support students' needs by helping establish a shared understanding between partners about the purpose of dual-credit for high school students, how it can best benefit students, and how to get students on a more strategic dual-credit path early on.

College advisors and high school counselors generally described learning their respective roles and responsibilities organically, while on the job—learning from past experiences and through regular communication with their counterparts at the high school and college. This more "on-the-job training" created challenges when there was turnover in advising staff. As one college advisor explained, the complexities of dual-credit education for new counselors coming in, particularly if they are coming from an elementary school or other type of counseling background, can create a steep learning curve. Similarly, another college dealing with recent turnover in high school counseling staff indicated the challenges of working with a new team, stating, "A lot of the information is just assumed that everybody knows it, but we have people coming from all different places and different backgrounds, and I do think refreshers on that information would be very just helpful." Some respondents also described challenges related to having to adapt to new leadership staff who impose new role and responsibility expectations.

Among those counselors that reported receiving training, a few described participating in formal meetings or sessions coordinated by their college partner. One counselor, for example, reported that the college held biannual meetings with all of their high school partners that involved the college vice president, a representative from admissions, the counseling office, and, on the high school side, the high school counselors and principal. Most, however, described more informal "training" environments, such as meetings with their college partner to learn about new updates or changes in policies and college procedures related to the dual-credit partnership. For example, one college advisor met with the CTE education director at the partner high school and her group of counselors annually to speak to them about the courses that were going to be available for dual credit, and the requirements there would be for the students to be able to enter the dual-credit CTE programs. Those high school counselors and

college advisors that had participated in more formal and informal trainings reported on the value of these opportunities to better understand their roles and how they can work with their partners to help ensure the success of the students opting to pursue dual-credit education coursework. Coupled with more robust training, many respondents suggested that having dedicated dual-credit college and high school advising staff would afford counselors and advisors more time to focus their time specifically on meeting the needs of dual-credit students, including more frequent one-on-one meetings with students.

Conclusions

In this chapter, we examined dual-credit student advising processes and procedures, as reported by 50 high school counselors and 52 college advisors working in a variety of dual-credit education partnerships and contexts. Following, we summarize our key findings in each of the topic areas we examined:

Students targeted for dual-credit education. All respondents indicated that they targeted students for dual-credit programs based on district policies for dual-credit and the MOUs that were in place with their partners. Within these parameters, there was some variation in the extent to which high school counselors and advisors actively recruited or encouraged certain types of students to apply. For example, some schools strongly encouraged all students to participate in dual-credit education, while others were more selective, targeting only those students who were excelling in their high school classes and demonstrating high levels of emotional maturity. Schools serving disadvantaged populations, had a clear focus on access and encouraging all students to participate in dual-credit education.

Roles of high school counselors and college advisors. The majority of high school guidance counselors played the primary role in advising dual-credit students, with one quarter sharing this responsibility with college advisors. College advisors typically played a secondary role, serving as the key point of contact for high school counselors and sharing information about dual credit with prospective students and their families. They became more involved, however, in special circumstances, including in the case of "accelerated students" or advising outside of the core, CTE dual-credit programs, freshmen and sophomores, and poor performance.

Coordination of advising activities. Overall, high school counselors and college advisors described close working relationships, most commonly to coordinate school visits and dual-credit information sessions, registering students, and course scheduling. They coordinated efforts related to students' application materials, registration, course scheduling, and transcripts and grades. Many counselors and advisors reported that they worked with each

other to develop materials, such as degree maps and course crosswalks, to help counsel students into certain courses or to help monitor and track students' progress toward meeting their high school graduation requirements or an associate's degree.

Course-taking considerations. High school counselors and college advisors most commonly reported considering students' postsecondary plans and likelihood of credit transfer when advising students into dual-credit courses. In addition, counselors and advisors frequently indicated using grade level as an indicator of students' readiness for certain courses. High school counselors also commonly reported guiding students into dual-credit courses that crosswalked to high school degree requirements or students' selected high school endorsement areas.

Advising challenges. High school counselors and college advisors expressed challenges related to high school students' academic and emotional readiness for dual-credit education, the latitude given to students in dual-credit course selection, and the limited time they had to fulfill all of their dual-credit advising responsibilities.

Suggestions to improve advising. High school counselors and college advisors suggested that greater clarity on credit-transfer policies and course alignment, starting the advising process earlier, more involvement from the college partner, and greater clarity in advising roles and having well-trained and dedicated dual-credit staff could improve student advising**.**

Chapter 3. The Academic Rigor of Dual-Credit Courses

Academic rigor is the focus of many debates around the quality of dual-credit courses (Baker, Burnett, & Ferguson, 2015). Concerns related to academic rigor are frequently raised in dual-credit policy discussions, yet there is no consensus on how to define it (Winston et al., 1994; Braxton, 1993; Hechinger Institute, 2009; Wagner, 2008; Blackburn, 2008). With enrollment in dual-credit courses increasing, a common understanding of academic rigor is necessary to ensure all dual-credit students have access to similar expectations and instructional methods as college credit-only students.

Phase I of the study uncovered systematic differences in instructor characteristics across dual-credit and college credit-only courses, which highlighted the need to determine the extent to which dual-credit students are held to the same academic standards as students in college credit-only courses (Miller et al., 2017). In response to this need, we designed a study to assess whether there are systematic differences in course content, assessment methods and standards, and teaching approaches between dual-credit and college credit-only courses. For this study we answered three questions:

RQ 1 What are the similarities and differences in the content and skills being offered in dual-credit courses and college credit-only courses?

RQ 2 What are the similarities and difference in the instructional practices being used in dual-credit courses and college credit-only courses?

RQ 3 What are the similarities and differences in how instructors of dual-credit courses and college credit-only courses assess student learning and student performance?

Given the large number of dual-credit programs and breadth of dual-credit courses being delivered in Texas, we decided to focus our efforts on two of the most common DC courses: English Composition I (English 1314) and College Algebra (Math 1314/1414). For each course, we attempted to recruit a sample of four faculty members delivering the course in three different settings: (a) as a college credit-only course taught by college faculty (CC), (b) as a dual-credit course taught by a college faculty (DC), and (c) as a dual-credit course taught by a high school teacher credentialed to teach a college-level course (HSDC).

The findings presented in this chapter contribute to a stronger understanding of the commonalities and differences in academic rigor between college credit-only and dual-credit courses. They also help policymakers identify where improvements in ensuring consistency in course rigor can be made to promote the long-term success of all dual-credit students in postsecondary pathways.

Organization of This Chapter

The remainder of this chapter is structured as follows: We begin by describing each of the four dimensions along which we compare dual-credit and college credit-only courses in terms of their academic rigor. Next, we describe the process we used to recruit faculty to participate in the study and the data we collected from them, as well as the protocol we developed and used to systematically compared the academic rigor of dual-credit and college-credit courses. We end this chapter with our findings.

How We Studied Academic Rigor

In this section, we describe how we conducted this study. Specifically, we share how we define academic rigor, describe our instructor sample and the data we collected, and the process we used to examine academic rigor of dual-credit and college credit-only courses.

Definition of Academic Rigor

There is no consensus on how to measure the academic rigor of a college-level course. Thus, it was necessary to develop a proxy to evaluate the extent to which dual-credit students are receiving instruction that is equivalent to that received by college credit-only students. To inform our work, we consulted the literature on academic rigor in mathematics and English language arts and identified four core dimensions that, together, serve as a gauge of academic rigor:

- ***Content***—The topics or domains of knowledge taught in a course
- ***Demonstration of skills***—The content specific skills students are asked to perform
- ***Instructional strategies***—The techniques or methods teachers use to help students reach their learning objectives
- ***Assessment of student learning and performance***—The strategies instructors use to determine student understanding of the content and the demonstration of knowledge.

We recognize that this definition is limited and does not encompass all of the materials and mechanisms instructors use to teach content and skills (e.g., it does not include course materials such as textbooks and other assigned readings). However, it is a starting point in assessing the equivalency of dual credit and college credit-only courses in terms of academic rigor.

Instructor Sample

With support of THECB, we identified a point of contact from an initial sample of 15 community colleges and 10 four-year institutions in order to identify HSDC, DC, and CC instructors who

taught Math 1314/1414 and English 1301 in the 2017 fall semester. These contacts, who were department chairs, deans, provosts, and chief academic officers, then chose high school teachers and college faculty who satisfied our selection criteria. After obtaining contact information, we sent out an e-mail to each selected instructor asking for their consent to participate. Because this study is exploratory, we set a goal of recruiting at least four instructors from English 1301 and Math 1314/1414 across our three course types, so a total of 24 faculty members.

In total, we secured 22 individuals from 17 HEIs, which included one four-year institution and sixteen community colleges across Texas. Table 3.1 provides the number of instructors who participated by the type of course they taught.

Table 3.1. Total Number of Participants for Each Course Type

Course Type	English 1301	Mathematics 1314/1414
College-Credit Only Course Taught by College Faculty (CC)	4	3
Dual-Credit Course Taught by College Faculty (DC)	4	4
Dual-Credit Course Taught by a High School Teacher (HSDC)	3	4

Data Sources

From each instructor, we attempted to collect: (1) the course syllabus, (2) a set of detailed assignments given to students at three different times points of the academic year (early, mid, and late semester), and (3) graded student work, which represented the full spectrum of grades (e.g., A, B, C, and F [or D if F not available]) that responded to the assignments that we collected. We also developed and administered an instructor survey to capture information about instructional practices, the types of assessments used to assess student learning, and content covered in the course.

In the following section, we describe the data collected from each source and why we considered it an appropriate source to assess content, the demonstration of skills, instructional strategies, and the assessment of student learning and performance. As mentioned previously, these course materials, individually and combined with instructor survey data, provide a holistic view of the level of academic rigor and commonality of rigor across dual-credit courses and college credit-only courses.

- *Course Syllabi:* Course syllabi contain information about the topics the instructor teaches in the course and the skills that students are required to demonstrate in order to receive course

credit. Data collected from the course syllabi analysis allowed us to compare the types of topics and skills instructors covered in a course and to gauge whether or not students in all course types have opportunities to engage with similar content and skill expectations.

- *Student Assignments:* We analyzed multiple assignments from English 1301 and Mathematics 1314/1414. Data collected allowed us to compare the level of rigor of instructor expectations of student assignments across course types. We asked instructors to upload one assignment/assessment on specific commonly taught topics in English and mathematics. English instructors uploaded a synthesis, a persuasive essay, and a final exam. Mathematics instructors uploaded a chapter test on polynomials and rational functions, a chapter test on exponential and logarithmic functions, and a final exam. We chose these topics from the initial review of syllabi, choosing one taught earlier in the semester, one from mid semester, and one from the end of the semester.
- *Graded Student Work:* We analyzed graded student work samples to compare how instructors graded students' level of mastery within and across course types. We asked instructors to submit an "A" or "B" sample of student work, a "C" and an "F" (or "D" if they did not have an F assignment) connected to the assignments mentioned above. We asked a varied set of samples so we could analyze different levels of mastery to determine if instructors were grading in similar ways. These data allowed us to compare the similarities and differences in the grading of student performance across course types in Mathematics 1314/1414 and English 1301.
- *Instructor Survey:* We administered a survey to collect information about the amount of time instructors across all three course types dedicated toward using specific instructional strategies, teaching common content topics, and employing different assessment methods. We also used data collected from the instructor survey to check whether content reported in the syllabi was actually being delivered in practice.

Table 3.2 summarizes the course materials we attempted to gather from each participating instructor.

Table 3.2. Instructor Materials Collected for Study

Course Syllabus	Assignments	Student Work Samples
Final course syllabus that satisfies the requirements of Texas HB 2504	English • Synthesis essay • Persuasive essay • Final exam Mathematics • Chapter test on polynomials and rational functions • Chapter test on exponential and logarithmic functions • Final exam	For each academic assessment, student work samples were submitted: • **First sample:** Scored an A or B • **Second sample:** Scored a C • **Third sample:** Scored an F (or D if instructor did not have a sample scored as an F)

Once we recruited instructors from all three course types, we sent them an e-mail with information about the types of data we sought to collect. Specifically, we asked each recruited instructor to complete a survey and upload syllabi, student assignments, and graded student work samples to an online data collection system. Table 3.3 shows the number of materials collected from instructors from each course type.

Table 3.3. Data Collected From Study Participants

English 1301—English Composition				
	Survey	**Course Syllabus**	**Student Assignments**	**Graded Student Work**
CC	4	4	6	18
DC	4	4	13	32
HSDC	3	3	9	21
Overall Totals	11	11	28	71
Math 1314/1414—College Algebra				
	Survey	**Course Syllabus**	**Student Assignments**	**Graded Student Work**
CC	3	3	9	16
DC	4	2	6	17
HSDC	4	3	12	36
Overall Totals	11	8	24	53

Note. Three Math 1314/1414 participants (two DC and one HSDC) took only the survey and did not upload documents.

Frameworks Used to Evaluate Academic Rigor

To assess the academic rigor of dual-credit versus college credit-only courses, we developed a protocol that drew elements from frameworks that have been previously used to assess student knowledge and skills. These frameworks include: (a) Novice-to-Expert Continuum (Conley, 2013); (b) Levels of Depth of Knowledge (Webb, 2002); (c) Marzano Center Essentials for Achieving Rigor Model (2014), and (d) Part A of the Surveys of Enacted Curriculum in Mathematics and English Language Arts (The Wisconsin Center for Education Research, 2012a, 2012b).

We shared the protocol with three external experts for review. After incorporating their feedback, we pilot tested the protocol on a sample of collected data without prior knowledge of the course setting (i.e., CC, DC, or HSDC). After reconciling differences, we then systematically coded the course data we collected and distilled information to identify similarities and differences across course settings. This approach allowed us to paint a rich picture of the content and skill expectations, instructional strategies, assignments and assessment methods, and graded student work employed across course settings in English 1301 and Math 1314/1414 and allowed us to objectively compare academic rigor across dual-credit and college credit-only courses.

Following, we describe the frameworks and sources we use to measure each dimension of academic rigor and explain how we applied them within the context of this study.

Analytic Procedures

Content and the Demonstration of Skills

We established a baseline for what is taught in college-level Math 1314/1414 and English 1301 based on two data sources:

- *College Algebra and English Composition Syllabi:* We reviewed a combined sample of 20 course syllabi from Math 1314/1414 and English 1301 courses that were available online to identify common topics taught in these courses along with the skills that students were required to demonstrate to receive credit for the course.
- *The Lower-Division Academic Course Guide Manual (ACGM)*: According to the THECB, the ACGM is the official list of approved courses for general academic transfer to public universities offered for state funding by public community, state, and technical colleges in Texas. For all courses listed in the ACGM, the THECB provides a list of student learning objectives (i.e., skills) that students are required to demonstrate to receive credit for the course.

The review of these two data sources allowed us to develop a list of common topics and skills taught in these two courses (see Table 3.4).

Table 3.4. Mathematics and English Content Areas

Mathematics 1314	English 1301
Polynomials	Text analysis
Rational functions	Source analysis
Radical functions	Research Skills
Exponential functions	Essay/composition development
Logarithmic functions	Idea development
Systems of equations using matrices	Identification of audience, purpose, occasion
Graphing	Stages of writing process • invention • researching • drafting
Nonlinear inequities	Thesis statements
Sequences and series	Paragraph construction
Circles	Informative, analytical and persuasive modes of writing
Binomial Theorem	Citation methods and technical aspects of writing identify rhetorical purposes and methods of organization appropriate to topic, thesis, and audience
Number systems	Paragraph construction
Probability	Audience, purpose and occasion
Conics	Citation methods and technical aspects of writing identify rhetorical purposes and methods of organization appropriate to topic, thesis, and audience
	Revision strategies (individual and collaborative)

Table 3.5. Mathematics and English Content Skills

Mathematics 1314	English 1301
Critical Thinking	Critical Thinking
Communication	Communication
Empirical and quantitative	Teamwork
	Understand writing process (planning, drafting, revising, editing)
	Making Inferences
	Drawing Conclusions
	Command of grammatical structure
	Develop computer literacy
	Analyze various types of written works
	Analyze purpose, audience, tone, style, and writing strategy when in written works

To assess the rigor of the academic content and skills required of students taught across three course types, we examined survey data and course syllabi from the study's participants.

- *Collected Syllabi:* We reviewed course syllabi to determine whether instructors of CC, DC, and HSDC courses taught common topics and required students to demonstrate specific skills identified in Table 3.5.
- *Instructor Survey:* One component of the survey asked the participating HSDC, DC, and CC instructors to report the amount of time they dedicated to teaching common topics identified in Math 1314/1414 and English 1301 courses. Unlike course syllabi, survey data allowed us to determine across the three course types whether instructors actually delivered content reported in course syllabi, and the amount of time they invested in teaching certain content and skills (by dedicating percent of time to the topic or skill over the course of the semester).

What we checked

- Do instructors cover content topics common across the baseline sample of course syllabus?
- To what extent are common content topics being taught by instructors?

Instructional Strategies

To evaluate the rigor of instructional strategies used by instructors across HSDC, DC, and CC courses, we drew on two frameworks:

- *Marzano Center Essentials for Achieving Rigor Model:* This model, developed by Dr. Marzano, an expert in content, pedagogy, and student assessment, evaluates the extent to which instructors teach in ways that meet college and career readiness standards. The 13 instructional strategies included in Marzano's model represent those that engage students in general higher-order thinking skills (see Text Box 3.1).

Text Box 3.1. Marzano's 13 Strategies for Rigorous Instruction

Interacting With New Content

- Identifying Critical Content
- Previewing New Content
- Organizing Students to Interact With Content

Practicing and Deepening New Content

- Helping Students Process Content
- Helping Students Elaborate on Content
- Helping Students Record and Represent Knowledge
- Managing Response Rates With Tiered Questioning Techniques
- Reviewing Content
- Helping Students Practice Skills, Strategies, and Processes
- Helping Students Examine Similarities and Differences
- Helping Students Examine Their Reasoning
- Helping Students Revise Knowledge

Cognitively Complex Tasks

- Helping Students Engage in Cognitively Complex Tasks

- *Surveys of Enacted Curriculum in Mathematics and English Language Arts:* These instruments were developed by the Council of Chief State School Officers and the Wisconsin Center for Education Research to examine the alignment between standards, curriculum, instruction, and assessment. We drew on these surveys to identify rigorous instructional practices specifically used in mathematics and English courses.

The instructor survey served as our primary source for assessing the rigor of the instructional strategies used in HSDC, DC, and CC courses.

- *Instructor Survey:* One component of the survey asked instructors to report on the amount of time they dedicated to using the specific strategies included in Marzano's model, and in the Surveys of Enacted Curriculum in Mathematics and English Language Arts.

What we checked

  - Do instructors use rigorous instructional strategies that engage students in general higher-order thinking skills?
  - Do instructors use rigorous instructional strategies that engage students in general higher-order thinking skills specific to mathematics and English instruction?
  - To what extent are instructors using these instructional strategies in practice?

The Assessment of Student Learning and Performance

Assessment of Student Learning

We drew on two primary frameworks to assess the level of student learning in HSDC, DC, and CC courses:

- *Marzano Center Essentials for Achieving Rigor Model:* In addition to evaluating the rigor of instructional strategies, Marzano's model can also be used to evaluate the cognitive complexity of student assignments. Broadly, cognitive complexity accounts for instructional practices that will help student engage with content at higher levels of cognitive demand. We specifically used this model to examine the extent to which instructors asked students to engage in cognitively complex tasks. Marzano defines cognitively complex tasks as tasks that require students to (1) engage in decision making that draws on breadth of knowledge and skills, (2) engage in problems solving within different contexts, (3) develop and test hypotheses, and draw conclusions from these tests, and (4) solve dilemmas or puzzles. In other words, these tasks require students to assess their knowledge and skills, and utilize them to solve real-world problems. An example of a cognitively complex task is summarizing news articles about the summer melt phenomenon and designing an experiment to test the effectiveness of an intervention intended to address this problem.
- *Webb's Depths of Knowledge (DOK) Levels Framework:* Webb's DOK framework is used to examine the cognitive demand of student assessments (Webb, 2002). We define cognitive demand as the degree of knowledge and level of thinking which students must demonstrate to engage in a specific task. Categorized into four discrete levels, each level reflects a different level

of cognitive expectation, or depth of knowledge, required to adequately respond to an assignment. Unlike Marzano's model, the DOK framework specifically focuses on the depth of understanding that is required of the student, not the design of the actual task (see Text Box 3.2).

Text Box 3.2. Levels of Depth of Knowledge (Webb, 2002)

Level 1: Recall and Reproduction

The lowest of all levels, tasks that fall under Level 1 require students to recall facts or perform rote procedures and do not involve the transformation of knowledge. Students who respond to Level 1 tasks knows the answer or does not, i.e., does not have to figure it out. Example: Adding two numbers.

Level 2: Skills and Concepts

At Level 2, a student must engage in some mental effort beyond what is needed to recall or reproduce a fact. Level 2 tasks typically require students to classify information into meaningful categories, transform information, explain relationships among other tasks. Example: Explaining how to perform a particular task.

Level 3: Short-Term Strategic Thinking

At Level 3, students must engage in short-term use of higher-order thinking skills. For example, tasks that fall under Level 3 require students to evaluate aspects of a scenario, solve real-world problems, or make an argument for or against a particular position. Example: Developing a questionnaire to gather information.

Level 4: Extended Thinking

Level 4 tasks require students to exert the highest level of cognitive effort. At this level, students demonstrate that they can summarize information from a variety of sources, identify information, come up with new solutions to problems where the outcome is unknown. Example: Designing an experiment that tests a variety of hypothesis.

Adapted from: *http://www.state.nj.us/education/AchieveNJ/resources/DOKWheel.pdf* and https://www.edutopia.org/blog/webbs-depth-knowledge-increase-rigor-gerald-aungs

As mentioned previously, we analyzed data collected from student assignments, course syllabi, and instructor surveys to assess how instructors across HSDC, DC, and CC course types assessed student learning, specifically the cognitive complexity and demand of student assignments.

- *Student Assignments:* Instructors from Math 1314/1414 and English 1301 across HSDC, DC, and CC course types submitted specific assignments used to evaluate student learning. We chose specific assignments for English and chapter tests for mathematics based on the content taught in these courses. We chose one assignment or test that would be given to students at the beginning of the semester, one from the middle of the semester, and one from the end of the semester. For each assignment we collected, we examined the extent

to which tasks within that assignment or test could be considered cognitively complex and required students to demonstrate higher levels of depth of knowledge. See Appendices F and G for the rubric used to assess the cognitive complexity of student assignments and the cognitive expectations that these assignments demanded in mathematics and English.

- *Course Syllabi:* We identified the types of assignments instructors gave students as reported in course syllabi. For example, we examined whether instructors in HSDC, DC, and CC courses assigned problem sets or gave quizzes to students enrolled in Math 1314/1414.
- *Instructor Survey:* The survey asked instructors to report the types of responses student assignments elicited. For example, the survey asked instructors to report the percentage of course assignments that used multiple choice responses versus those that required students to explain or justify a response.

What we checked

- To what extent are student assignments cognitively complex?
- To what extent do assignments require students to demonstrate higher levels of depth of knowledge?
- What kinds of assignments do instructors give students? And what kinds of responses do they elicit?

Assessment of Student Performance

Samples of graded student work we collected from instructors represented the full spectrum of grades that could be awarded (i.e., grades A, B, C, and F [or D if an F-graded sample was not available]). To assess the extent to which the instructors in our sample consistently awarded A, B, C, and F (or D) grades to student work of the same level of cognitive development and competence, we drew on the Novice-to-Expert Continuum, which we describe in more detail below.

- *Novice-to-Expert Continuum:* Developed by David Conley, an expert in college readiness, the Novice-to-Expert Continuum is a seven-level scale that assesses a student's cognitive development and learner competence around six key concepts: (1) insight, (2) efficiency, (3) idea generation, (4) concept formation, (5) integration, and (6) solution seeking (Conley, 2013). Instructors can use this continuum to assess the level at which students demonstrate competence along these six concepts.

For each graded student work categorized as an A or B, C, and F (or D) across the three course types, we examined whether the student had exhibited competencies embodied within the seven levels of the Novice-to-Expert Continuum. For example, did student assignments given As

demonstrate characteristics emblematic of an "Emerging Expert" (highest level of the continuum)? For an assignment to be categorized at a certain level of the continuum, students had to exhibit a majority of traits characteristic of that level.[10]

Table 3.6. Novice-to-Expert Continuum (Conley, 2013)

Levels	Concepts
Emerging Expert	☐ Ability to apply knowledge in a variety of contexts ☐ Holistic understanding of subject matter rather than fractional understanding of subject matter ☐ Abstract thinking and strong ability to synthesize and integrate information ☐ Developed "Conceptual understanding"—the why
Accomplished Strategic Thinker	☐ Ability to apply abstract thinking, ability to synthesize and integrate variety of sources and information ☐ Command of "conditional knowledge"—the when—when to apply the knowledge ☐ Developing holistic understanding of subject matter rather than fractional understanding of subject matter ☐ Developing "conceptual knowledge"—the why
Strategic Thinker	☐ Able to apply insight, idea generation, concept formation and integrate different subjects/topics ☐ Deep understanding of subject matter ☐ Developing abstract thinking, analytical skills and ability to synthesize/integrate information ☐ Developing command of "conditional knowledge"—the when—when to apply the knowledge
Emerging Strategic Thinker	☐ Developing ability to apply insight, idea generation, concept formation and integrate different subjects/topics ☐ Able to analyze information and discern patterns in information due to familiarity with subject ☐ Command of "procedural knowledge"—the how
Accomplished Novice	☐ Connecting subject matter to big ideas, aware of complexity of subject ☐ Developing contextual knowledge ☐ Meets basic expectations and guidelines ☐ Ability to interpret and apply information ☐ Demonstrates "declarative/descriptive knowledge"—the what
Novice Thinker	☐ Superficial understanding of subject area, concept formation, solution seeking skills ☐ Developing ability to interpret and discern rules and guidelines regarding basic standards
Emerging Novice	☐ Limited background in subject area, minimal contextual understanding of subject ☐ Developing ability to meet basic standards and requirements

[10] As one of our external reviewers, Dr. Conley reviewed and approved our adaptation of the Novice to Expert Continuum for this study.

What we checked

- To what extent does student demonstrate characteristics/competencies identified within each level of the Novice-to-Expert Continuum?

Limitations

The analysis presented in this chapter is exploratory in nature and reflects a relatively small sample of dual-credit and college credit-only courses and course instructors in Texas. In addition, our analysis is not based on any observations of instruction or any measure of quality of instruction. The intent of the study is to provide initial insight into the content expectations, the instructional strategies, and how instructors assessed student learning and performance across different delivery types of dual-credit and entry-level college courses. Although this study is limited in its ability to make definitive conclusions about the similarities and differences in rigor across dual-credit and college-level courses, it provides a model methodology that could be applied in future studies with larger numbers of participants. This would allow researchers to draw stronger conclusions about the rigor of content covered instructional approaches. In addition to a large-scale study, the methodology here could be used by a small group of instructors to ensure standardization of course content, expectations for the cognitive complexity and cognitive demand of assignments, and that students are being graded similarly for demonstrating similar levels of content mastery.

Findings

English—Content

All course types focused on these core components: essay/composition development, idea development, stages of the writing process, thesis statements, and informative, analytical, and persuasive modes of writing.

All syllabi submitted by CC, DC, and HSDC instructors explicitly stated each of these topic areas would be covered in the course. In addition, the instructor survey data indicated that instructors in all three course types spent similar amounts of time on each of these core topics. These findings indicate that there was little difference in delivered content by CC, DC, and HSDC instructors.

However, we discovered that HSDC and DC instructors had higher expectations for mastering certain content areas. Compared to HSDC and DC course instructors, CC instructors had lower expectations around how to write a thesis statement and construct paragraphs. CC instructors

also had fewer requirements regarding the development of thesis statements and paragraph construction, while almost all the HSDC and DC syllabi reviewed included explicit guidelines for both. For example, a syllabus collected from a CC included the following statement regarding development of thesis: "identify rhetorical purposes and methods of organization appropriate to topic, thesis, and audience" yet had no assignments focusing on thesis development. Whereas in one DC syllabus, the expectations regarding thesis statement skills were not only included in the course objectives but were also paired with a reading assignment that explored how to write a thesis statement. Another HSDC syllabus required students to take a thesis statement quiz with a paragraph construction assignment in the first week of classes.

Demonstration of Skills

Nearly all syllabi we reviewed required students to demonstrate similar skills.

When reviewing course syllabi, HSDC, DC, and CC instructors required students to demonstrate the same set of skills. These included: critical thinking skills; communication skills; teamwork; understand writing process (planning, drafting, revising, editing); analyze purpose, audience, tone, style, and writing strategy in written works. This finding indicates that across course types, instructors believed that these seven skills were essential to student success in English 1301.

Instructional Strategies

HSDC, DC, and CC instructors reported dedicating similar amounts of instructional time to specific tasks, yet some differences exist.

Instructors across course types spent the highest amounts of time engaging students in reviewing and revising work, and collecting, summarizing, and analyzing information or data from multiple sources, and asking students to engage in the writing process to support arguments with evidence. This correlates with course content and skill expectations for an English 1301 course and is similar to the expectations found in the Surveys of Enacted Curriculum in English.

Yet, we found that differences existed on the amount of time HSDC, DC, and CC instructors dedicated to other tasks. For examples, participation in whole-class discussion about writing and reading exercises was given the second highest percentage of time among CC instructors; for HSDC instructors, engaging students in using a computer to learn, practice, or explore writing and reading content came in second. For DC, use of a computer was also the second highest percentage of student engagement during instructional time, but not as high as HSDC. On the opposite end, CC instructors allocated the lowest amount of instructional time for

students to maintain a portfolio, DC instructors spent the lowest amount of instructional time for students to present or demonstrate to others, and HSDC instructors gave the lowest amount of instructional time for students to engage in metacognitive exercises.

Assessment of Student Learning and Performance

HSDC, DC, and CC instructors gave students similar assignments to assess their learning and performance.

Quizzes, papers, presentations, and student participation in class were almost always used for assessing student learning and contributed to the overall grade for most courses. The weight attributed to each assignment in determining the student's overall student grade varied; however, we did not find evidence showing that instructors of HSDC, DC, and CC courses used differing grading schemes.

HSDC, DC, and CC instructors gave students assignments that required similar levels of cognitive demand.

In our review of 30 assignments, including final exams and persuasive and synthesis essays, we found marked similarities in the level of cognitive demand required by them across course types. All prompts for the persuasive essay were rated as meeting the requirements for the third level of cognitive demand, Short-Term Strategic Thinking. At this level, students are asked to engage in short-term use of higher-order thinking skills. For example, tasks that fall under Level 3 require students to evaluate aspects of a scenario, solve real-world problems, or make an argument for or against a particular position. Similarly, all final exams were rated at the fourth level of cognitive demand, Extended Thinking. At this level, students are asked to exert the highest level of cognitive effort. At this level, students are required to demonstrate that they could summarize information from a variety of sources, identify information, and devise new solutions to problems where the outcome is unknown.

Assignments developed by HSDC, DC, and CC instructors were similar in terms of cognitive complexity.

All assignments were rated with similar rankings in terms of cognitive complexity. For instance, all of the synthesis essays were ranked at the second level of cognitive complexity, which in the scale used was "practicing and deepening new content." The essays reviewed asked students to do more than interact with new content, they asked students to elaborate on content, examine similarities and differences, and examine their reasoning. Similarly, all of the final exams were

rated at the third level of cognitive complexity, Cognitively Complex Tasks. The final exams required students to engage in solving a problem, analyzing options, and drawing conclusions.

There were no clear differences in the level of student performance across course types.

The researchers examining 42 examples of student work—that correspond to the assignments above—and rated each student work on a novice-to-expert continuum in order to analyze student performance across the three course types. Each student work was graded by the instructor as an "A", "B", "C", "D" or "F" assignment. Instructors from each course type submitted these graded student works. Then the researchers rated the graded student works along the novice-to-expert continuum.

In the review of graded work samples, researchers found that the final exam and persuasive and synthesis essays that were graded with an "A" or "B" across course types demonstrated the qualities of the "Strategic Thinker" level of the Novice-to-Expert Continuum. For example, a persuasive essay submitted by a HSDC instructor demonstrated that a student was able to use insight to form a deep understanding of concepts related to specific subject matter such as focusing on concussion protocol in football. Similarly, a persuasive essay submitted by a CC instructor demonstrated that a student was able to apply insight and use analytical skills to synthesize/integrate information focusing on organ donation. Similarly, all "C" work was identified at the "Emerging Strategic Thinker" level and "D" and "F" work were rated at the "Novice Thinker" level across all courses.

Mathematics—Content

All course types focused on these core components: polynomials, rational functions, radical functions, exponential functions, logarithmic functions, systems of equations using matrices, and graphing.

All syllabi reviewed across course types explicitly stated each of these seven content areas. In addition, the instructor survey data indicated that instructors in all three course types spent the largest percentage of instructional time on these core topics. These findings indicate that these were the primary content areas taught consistently across the three course types.

All course types spent minimal or no instructional time focused on circles and the Binomial Theorem. No syllabi from any of the three course types indicated either circles or the Binomial Theorem as a content focus. This was confirmed in the instructional survey, in which instructors across all course types reported spending less than 10% of instructional time on circles content or no time at all. Apart from one HSDC instructor who reported spending between 10% and

25% of instructional time on the Binomial Theorem, instructional survey responses indicated minimal or no time spent on this topic across groups.

Content focused on number systems was more prevalent within CC courses. All the HSDC and DC syllabi we reviewed omitted these content areas. However, number systems content was present in two of the three CC syllabi reviewed. For DC courses, the instructional survey also highlighted a lack of instructional time spent on this topic, with zero instructors indicating 10% or more of instructional time spent on number systems, and three of four indicating that no time is spent at all. For CC courses, instructional survey responses from two of the three respondents indicated time spent on the number systems topic.

Less instructional time was spent on sequences and series in CC courses. None of the CC syllabi review mentioned sequences and series as an instructional topic. These omissions were confirmed by the instructor survey, in which two of three college-entry-level professors indicated no time spent at all, and the third indicated less than 10% of instructional time spent on the sequences and series topic. Sequences and series were present in all reviewed DC syllabi, along with two of the three HSDC syllabi.

Demonstration of Skills

Presentation and demonstration skills were developed minimally across all three course types.

Evidence from the survey responses also indicated that the use of instructional time asking student to present or demonstrate to others is minimal across course types. All respondents, apart from one, indicated that either less than 10% of time or no time at all was used on presentations or demonstrations. One CC instructor indicated that he or she utilized between 10% and 25% of instructional time asking students to present or demonstrate.

All three course types spent a significant amount of time developing students' skills in technology, computer, and calculator use.

Instructor survey responses from across course types indicated that they spent equal time asking student to *Use computers, calculator, or technology to learn, practice or explore mathematics.* Apart from one CC instructor and one DC instructor who indicated minimal use of technology, the rest of the respondents across course types reported that technology was used between 10% and 50% of instructional time. In addition, two HSDC instructor and one CC instructor reported that technology is used during more than half of instructional time.

General mathematics skills were consistently and explicitly stated in syllabi for CC courses.

Utilizing data from the course syllabi, it was determined that some courses establish expectations for the development of core skills through the students' engagement with the content. The four skills targeted for development include critical thinking skills, communication skills, empirical skills, and quantitative skills. All four skills were explicitly listed in the CC syllabi, with one referring to them as *"in support of the objectives of the Texas core curriculum."* It was also noted in the same syllabus that *"[t]hese objectives form a foundation of intellectual and practical skills that are essential for all learning."* None of these skills were listed in any of the HSDC course syllabi, and only one DC course syllabus had these skills listed. The fact that these were explicitly stated in all CC courses and not HSDC courses may signify a standardization of defined skills within Algebra across Texas colleges.

CC instructors spent more instructional time developing reading and comprehension skills.

Survey responses indicated that CC courses spend more instructional time asking students to *Read and comprehend mathematics information from multiple sources*, with responses ranging from 10% to more than 50%. Meanwhile, three of four DC professors indicated spending less than 10% of instructional time on the same skill, and the use of instructional time for HSDC courses ranged from none to 25%. These findings may indicate more complex and varied materials with CC courses.

Instructional Strategies

Compared to DC and HSDC courses, CC courses placed greater emphasis on individual work and more often required comprehension of information from multiple sources.

Instructors were also asked what activities they spent their class time on. The potential responses to this question were "None," "Less than 10%," "10-25%," "26-50%," and "More than 50%." Table 3.7 shows a weighted average of responses by course type.

These weighted averages are helpful for comparing course types, although it is important to keep in mind that the range sizes of the potential responses from instructors are different. For example, if one instructor responded that they allocated 'Less than 10%' of instructional time for students to work individually, this response would receive a weight of 1. While, if another instructor reported they asked students to work individually during "26-50%" of instructional time throughout the semester, this response would receive a weight of 3. Summing these weights and dividing by the number of responses provides us with a weighted average. In the above example the result would be a weighted average of 2. The difference in the bin size of

response options limits us to directional conclusions rather than precise percentage point differences in how instructional time is spent. The highest possible score in each category is 4.

Table 3.7. Weighted Average of Instructor Reported Use of Class Time

	HSDC	CC	DC
Listen to the teacher explain, or observe the teacher demonstrate or model a mathematics procedure or solve a problem.	2.75	2.33	2.25
Read and comprehend mathematics information from multiple sources.	1.25	3	1.25
Collect, summarize, or analyze information or data from multiple sources.	1	1.33	1.25
Present or demonstrate to others.	1	0.67	0.25
Work individually on mathematics assignments.	2	3.33	2.25
Participate in whole-class discussions about mathematics.	2	1.33	1
Work in pairs or small groups on mathematics exercises, problems, investigations, or tasks.	1.75	1	1.25
Use computers, calculator, or technology to learn, practice or explore mathematics.	3.25	2.67	2
Maintain a portfolio of their own work.	1	0	0.75
Review and revise work.	2.25	2	1.75

Across all course types, instructors reported spending little to no instructional time asking students to present to others or maintain portfolios of their work. Ten of the 11 instructors reported spending either less than 10% or no class time asking students to *present or demonstrate to others.* Similarly, nine out of 10 instructors reported spending either less than 10% or no class time asking students to *maintain a portfolio of their own work.*

Assessment of Student Learning and Performance

HSDC, DC, and CC instructors gave students similar assignments to assess student learning and performance.

Based on collected course syllabi, we found that HSDC, DC, and CC instructors gave students similar assignments to determine their learning and performance. All syllabi included a final exam, some form of chapter tests or midterms, and all but one included some variant of

homework as the main graded elements. Quizzes were used by all CC instructors, two out of three HSDC instructors, and one out of two DC instructors.

The main assignments, final exams, chapter tests/midterms, quizzes, and homework determined similar portions of students' grades across course types.

On average, cumulative final exams made up roughly 20% of students' final grades in all course types, chapter tests/midterms accounted for roughly 50%, homework for 10% to 15%, and when included, quizzes accounted for 15% to 20% of students' final grades.

HSDC, DC, and CC instructors gave students assignments that required similar levels of cognitive demand.

In our review of 27 assignments including chapter tests/midterms and final exams, we found marked similarities across course types. All assignments were rated as meeting the requirements for the second level of cognitive demand, skill/concept. At this level, students are asked to use conceptual knowledge to solve problems that often require two or more steps to solve. Two sample activities that meet this requirement are "Retrieving information from a table, graph, or figure and using it to solve a problem requiring multiple steps" and "Solving a routine problem requiring multiple steps, or the application of multiple concepts."

Assignments developed by HSDC, DC, and CC instructors were similar in terms of cognitive complexity.

All assignments were also ranked at the second level of cognitive complexity, which in the scale used was "practicing and deepening new content." The exams reviewed asked students to do more than interact with new content but did not meet the criteria for the highest level of cognitive complexity as the problem solving involved was routine and not asking students to devise new methods of finding solutions.

Short answer questions was the most common method of assessing students across HSDC, DC, and CC course settings.

Presentations, projects, and portfolios were uncommon across all course types.

Table 3.8. Weighted Average of Instructor Reported Use of Assessment Strategies

	HSDC	CC	DC
Multiple choice or true/false items	2	0.67	1.25
Short answer questions such as performing mathematical procedure	2.75	3.33	3.75
Extended response item for which students must explain or justify a solution	1.5	1	1
Performance tasks (hands-on activities)	1	1	1
Individual or group demonstration or presentation	0.25	0.67	0.5
Mathematics projects	0.5	0	0.5
Portfolios	0.25	0	0.25

HSDC instructors more frequently than CC instructors reported using choice and true/false questions.

One potential difference between course types was in the use of multiple choice and true/false questions, with CC courses having used them least often and HSDC courses having used them more often. These findings are based on instructor survey responses and are not based on actual counts of each question type or within assignments or type of assignment reviewed.

There were no clear differences in the level of student performance between course types.

To measure student learning and mastery of content, we reviewed 70 samples of graded student tests and rated them on a novice-to-expert continuum. By examining the number of questions students answered correctly, which types of questions they answered correctly, and how much or how little work they showed to reach their answers, we got a sense of students' depth of knowledge and mastery.

Student work looked similar across all three course types. That is, an example where a student earned an F letter grade in an HSDC course looked like an example that earned an F in a CC course. Likewise, student work that earned an A in HSDC or DC courses looked like student work that earned an A in CC courses. Combining this finding with the earlier finding that all assignments were rated at the same level of cognitive demand and complexity, we did not find any systematic differences in the level of student performance between course types. See Table 3.9 for an overview of how the instructor assigned letter grades aligned with researcher assigned novice-expert continuum ratings for the student work examples.

Table 3.9. Counts of Assignments by Grade and Rating on Novice-to-Expert Continuum

	HSDC			CC			DC		
Grade	**Novice**	**Strategic**	**Expert**	**Novice**	**Strategic**	**Expert**	**Novice**	**Strategic**	**Expert**
A		5	6		2	2		1	5
B	1	1			2				
C	5	7		2	2		2	4	
D	6			2			2	1	
F	5			5			2		

Conclusion

The purpose of this component was to gain a better understanding of the similarities and differences in academic rigor between dual-credit and college credit-only courses. Our analysis provides insight into the level of rigor that is present in course expectations across all three course types to begin to get a better understanding of what similarities and differences there are that may impact the level of rigor in a course. Following, we summarize our key findings we examined:

A high degree of similarity exists in the content and skills taught in English 1301 and Math 1314/1414 HSDC, DC and CC course types. Across all course types, English 1301 syllabi required students to demonstrate specifically skills including: how to think critically, communicate thoughts and ideas clearly, and work in terms. They also reported similar learning outcomes, including understanding the stages of the writing process (planning, drafting, revising, editing) and analyzing the purpose, the audience, the tone, the style and the writing strategies in written works. Similarly, Math 1314 syllabi collected from all three course types revealed that each one focused on teaching students seven core concepts in Algebra: Polynomials, Rational Functions, Radical Functions, Exponential Functions, Logarithmic Functions, Systems of Equations using Matrices, and Graphing.

Student grading is consistent across all course types in Mathematics 1314 and English 1301. Letter grades given for similar assignments are aligned across course types. All student work was individually analyzed using a novice—expert continuum. This analysis of student work demonstrates a consistency of grading across course types, for instance, student work graded as an “A” or “B” was scored as “Strategic Thinking Level” across all course types.

HSDC, DC and CC English 1301 and Mathematics 1314 instructors focus on different of instructional strategies in their courses. Instructors across English 1301 course types reported devoting differing amounts of instructional time to the various instructional tasks**.** For HSDC and DC English 1301 courses, instructors report devoting most of their time to requiring students to participate in whole-class discussion about writing and reading exercises, while CC English 1301 instructors report requiring students engage in computer-based writing for the highest percentage of the course time. Similarly, CC Mathematics 1314 instructors placed a greater emphasis on individual work and more often required comprehension of information from multiple sources than DC and HSDC instructors.

HSDC, DC and CC English 1301 instructors use common methods for assessing student performance. Across the three course types, English 1301 instructors reported using the following assessment methods: quizzes, cumulative final exam, papers, presentations, and portfolios**.** Written essays was the most common work product instructors used to assess student performance (50% of overall grade) with a cumulative final as the second most common (25% of overall grade).

HSDC, DC and CC Mathematics 1314 instructors place a different emphasis on assessment strategies. While Math 1314 instructors across all course types used some similar assessments, primarily final exams, chapter tests/midterms, and homework, to determine students' grades, HSDC and DC instructors reported using multiple choice and true/false questions more frequently than CC instructors. CC courses also placed greater emphasis on extended response questions and more often required comprehension of information from multiple sources than HSCD or DC courses.

Chapter 4. The Costs of Delivering Dual-Credit Education

The availability of dual-credit courses in Texas has expanded rapidly over the last decade. At South Texas College, for example, dual-credit courses were first offered in 2006 to 28 students. By 2016, almost 16,000 students took courses as dual-credit students (Perez-Hernandez, 2016). Statewide, dual-credit enrollment increased by 215% from 2006 to 2015 (Legislative Budget Board Staff, 2017).

One concern with the rapid expansion of dual credit is the cost of such courses, and the manner in which those costs are distributed across stakeholders. Here, we define costs as the monetary value of the resources used to deliver dual-credit education programs that would not be otherwise be used to deliver traditional nondual-credit high school instruction and support services.

We identify community colleges, school districts, and students and their families are the key stakeholders who bear the cost to deliver dual-credit education with the understanding that funding for community colleges and school districts largely comes from state and local taxes. Tuition agreements play a central role in determining who bears the costs of dual credit. According to the work by Pierce (2017), Texas is one of 13 states (plus the District of Columbia) where the decision about who pays for tuition is made at the local level by community colleges and school districts. According to data collected by the Texas Association for Community Colleges (TACC) (2017), in FY 2016 community colleges in Texas employed a variety of tuition arrangements, with the most generous being waiving tuition and fees completely. The most common approach, according to TACC data, was to provide a partial waiver or charge a flat fee per semester credit hour that was generally less than full tuition. As a result of offering college courses at a discounted rate, colleges have been concerned that revenue sources are not covering the cost of providing dual-credit courses (Express-News, 2018; South Texas College, 2015).

The cost to colleges, however, is but one source of the overall costs of providing dual credit. There are also costs to school districts, which have to coordinate dual-credit opportunities with colleges and advise students regarding dual-credit opportunities, and potential costs to students, who may be responsible for purchasing textbooks, traveling to community colleges, and paying tuition and fees. Furthermore, the cost burden might be shared in a variety of ways by the three parties that make up a dual-credit partnership (community colleges, public school districts, and students and their families), leading to substantial variation across Texas regarding who pays the costs of dual credit. This adds a level of complexity to the analysis and reporting of findings (Legislative Budget Board Staff, 2017).

While the rapid expansion of dual-credit poses its challenges, with cost being one of them, the expansion of dual-credit options also has benefits for high school students. Participation in higher education has been shown to have many benefits to individuals in the form of higher earnings and other factors improving quality of life as well as society at large (McMahon, 2009). Because of these benefits, Texas has created 60x30TX, the state's ambitious Higher Education Strategic Plan. This plan sets goals of 60% of 25- to 34-year old Texans having a certificate or college degree by 2030, increasing the number of students per year completing a certificate or degree, improving marketable skills of college graduates, and reducing debt (Texas Higher Education Coordinating Board, 2015). Increasing the participation of economically disadvantaged high school students in dual credit and other college-level courses is one strategy for helping the state attain these ambitious goals.

Purpose

The goal of the cost component of the Texas Dual-Credit Education Study is to estimate the cost of providing dual-credit programs across the state, while showing what accounts for the costs and which stakeholders pay for the costs. The cost analysis is designed to yield several types of information that will be useful to policymakers, practitioners, and researchers.

First, the cost analysis provides an understanding of the types and quantities of personnel and nonpersonnel resources used to deliver dual-credit courses to students, as well as the corresponding cost of those resources. To this end, the cost information shows the cost of replicating a dual-credit program at a new site and thus provides information to determine the feasibility of doing so. The information is valuable not only in providing a general account of the costs, but also as a reference that can be used to consider how resource usage might be adjusted to improve delivery of dual-credit courses. In addition, knowing the costs of providing dual-credit courses is important for understanding the total effort involved in sustaining such programs over time.

Second, the study sheds light on how the burden of these costs is shared over a variety of stakeholders, including community colleges, public school districts, and students and their families. This information can be used by policymakers in refining mechanisms to appropriately fund dual-credit programs.

Finally, beyond understanding the cost structure of dual-credit programs and who pays for these programs, ultimately policymakers want to know if the investment worth it. To this end, we examine the benefits of dual-credit education and compare these to costs. We monetize the improvement in student outcomes identified in the impact analysis. Furthermore, we

categorize benefits as those benefiting the students who take dual credit and benefits to the public at large. By categorizing benefits in this way, we can estimate both the private and public return on investment for dual credit.

Cost Study Methodology

As defined earlier, the *cost of dual-credit education* is the total amount of resources provided by colleges, school districts, and students, to deliver dual-credit education programs, that would not otherwise be used in a traditional, nondual-credit high school setting. Importantly, state funding for colleges and K–12 school districts, as well as tuition payments, are not costs, but rather *cash transfers* that shift the burden of costs. As we discuss in the subsections below, our study includes two analyses of cash transfers. First, we analyzed state funding data to determine how any additional funding from the state that community colleges and school districts receive for dual credit compares to the costs. Second, we studied how tuition payments alter the distribution of costs. These two types of cash transfers–state funding and tuition payments – do not add to the overall costs (as they are not tangible resources), but rather shift how costs are distributed among stakeholders.

We also identify who is responsible for different types of costs. Costs can be paid for by community colleges, school districts, or students and their families. Costs to community colleges and school districts are "public" costs, which are funded through tax revenue raised at the local, state, and federal levels. Costs to students and families are private costs, which are funded directly by the students and families of students receiving dual credit.

Sample Selection

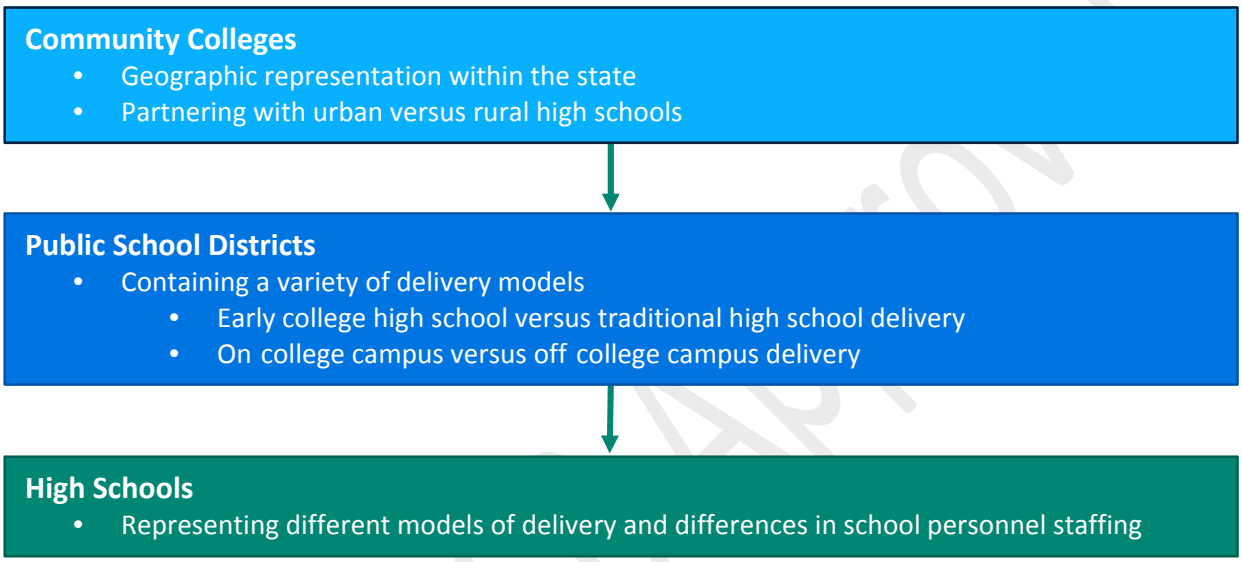
For the cost analysis, we first selected a purposive sample of dual-credit partnerships, consisting of community colleges and their partner public school districts and high schools (Figure 4.1).[11] The sample of partnerships were selected to ensure variation in geographic location (including both urban and rural areas); dual-credit delivery models, including courses offered on-site (i.e., at the community college campus) and off-site (i.e., at the high school); and high school model (ECHSs and traditional high schools).[12] Specifically, we first selected five community colleges—three that serve relatively urban partnering high schools and two that

[11] Several community colleges selected are community college districts having multiple campuses.

[12] Due to the substantially different resources required for CTE dual credit, and the relatively low prevalence of this type of dual credit offering, we did not perform in-depth cost analysis of CTE dual credit programs. However, we performed a broad scan of the research on differential costs of CTE. In addition, all the community colleges sampled provided CTE courses. We captured elements of these programs in our data collection.

serve more rural high school partners.[13,14] From those community colleges, we selected a set of partnering public school districts of varying sizes containing high schools that use various dual-credit delivery models. This sampling approach allowed for comparative analysis between dual-credit programs in these various contexts. We used information on costs from both the college and school districts to develop comprehensive costs of dual credit.

Figure 4.1. Illustration of Sampling Plan for Cost Analysis



The Ingredients Approach

We used the *ingredients approach* to costing out educational services as initially developed by Levin (1983) and recently updated by Levin et al. (2018). Following the ingredients approach, we focus on the additional costs associated with the provision of dual credit (i.e., above those costs that would be incurred in a traditional nondual-credit high school setting).[15] The approach involved identifying the comprehensive list of "ingredients"—personnel and nonpersonnel resources such as instructor time and textbooks—associated with providing dual-credit education, including their quantities and unit prices.[16] Quantities of ingredients and unit prices were used to cost out each ingredient, which were then aggregated to provide an estimate of

[13] Urban and rural definitions are based on census locale definitions that are also used by the National Center for Education Statistics (see https://nces.ed.gov/programs/edge/docs/LOCALE_DEFINITIONS.pdf).
[14] We chose to focus only on community colleges offering dual credit because community colleges offer approximately 95% of all dual-credit instruction in Texas.
[15] The ingredients method is widely accepted as the preeminent method for cost analysis in economic evaluation research. The method is recognized by National Research Council and used by the World Bank, the Massachusetts Institute of Technology Jameel Poverty Action Lab, and the U.S. Agency for International Development.
[16] For personnel, the ingredient "prices" are defined as full compensation for different staff types including both salaries and benefits.

the overall cost in total and on a per-semester credit hour basis. We categorized the ingredients according to whether they represented personnel or nonpersonnel resources, who bore the cost (community colleges, public school districts, or students and their families), and by functional categories (administration and advising, instruction, or other). By categorizing resources in this fashion, we were able to break down the overall costs and costs per semester credit hour in several ways. Of particular importance, we can determine how costs are shared among various stakeholders (i.e., community colleges, public school districts, and students and their families). The cost burden to students and their families is of special interest, given the student debt goal in *60x30TX*.[17]

The costs we considered were only those related directly to the provision of dual credit and are extraneous to the general operation of schools.[18] The intention of the analysis is to isolate the differential costs of dual-credit instruction compared with traditional high school instruction. That is, how much more (or less) does it cost to provide students with dual-credit instruction compared with traditional high school instruction?

Data Collection

To conduct the cost analysis, we gathered extant data and conducted primary data collection. Specifically, extant data consisted of statewide data from 2016–17 obtained from THECB and TEA on dual-credit enrollment, instructor salaries, and high school personnel staffing levels. We also analyzed extant data, when available, from the sampled set of study sites. These data included fiscal data on dual-credit spending from community college accounting systems, as well as documentation of service arrangements between colleges and partnering school districts and high schools. This documentation included information obtained through MOUs between community college and school district partners. The extant data were used to determine quantities of certain ingredients that were clearly identified in the data (e.g., the number of dual-credit instructors who are full-time college faculty) and were used to establish average prices of these ingredients (e.g., the compensation associated with a typical full-time college faculty member providing dual-credit instruction). In addition, the extant data contained key information such as the tuition arrangements between colleges and school districts.

Because the extant data were generally not sufficiently detailed or comprehensive enough to identify all costs in the delivery of dual-credit programs, we also conducted interviews at each

[17] See http://www.60x30tx.com/goals/goal-four-student-debt/

[18] In addition, because costs related to facilities are relatively fixed—meaning they do not vary with respect to small changes in numbers of students—we did not include facilities costs in this analysis.

community college and school district site. These interviews were necessary to obtain more granular information on how the dual-credit program is delivered within each study site and the specific resources that are required. For example, at each of the school districts sampled, an administrator was responsible for overseeing dual credit. In some cases, this was their primary responsibility, and in other cases, this was only one of many responsibilities. Some districts provided administrative support for these staff and provided significant travel reimbursement throughout the school year, while others provided less support. To accurately calculate the cost of delivering dual-credit courses, we asked interviewees to estimate the percentage of time spent by the various staff involved with activities related to the dual-credit program.

Developing a Resource Cost Model

To calculate the overall costs associated with the dual-credit program at each of the participating study sites, we developed what is known as a resource cost model (RCM). The RCM is a tool to organize the resources identified in interviews and extant data, apply prices, and calculate overall costs and costs per SCH. The RCM was developed using Microsoft Excel and performs a series of calculations to convert types and quantities of resources into costs.

As previously mentioned, to calculate costs, we needed prices and quantities of ingredients. The quantities of ingredients were largely obtained from interviews or extant data. In some cases, quantities of resources were clear from these sources. In other instances, we had to make some assumptions about the uptake of certain resources. For example, each site reported that students must take the TSIA to determine their eligibility for many dual-credit courses. The TSIA requires a fee per testing unit for each subject area. School districts did not have information on the number of TSIA tests given over the course of a school year readily available but could offer estimates on the number of testing units each dual-credit student takes. Based on those estimates, we made assumptions of the number of testing units that districts paid for each year. In most cases, the resources for which quantities were not clearly apparent from the interviews were nonpersonnel items that were only minor contributors of cost.

In some cases, prices of ingredients also came from the interviews or extant data. In many cases, however, we had to use alternative sources of information to determine prices. Following the ingredients method, we assigned salaries commensurate with the experience and educational level of personnel. This strategy allowed us to estimate the cost of producing dual credit (the value of resources used), rather than the expenditures of dual credit that are specific to a given context. In the case of instructors, we used data from THECB on salaries. For other staff positions, such as administrative staff, counselors, and school principals, we used data

from the 2016 Bureau of Labor Statistics Occupational Employment Statistics data as standard prices for various types of staff.

We used the quantities and prices of the various resources allocated to producing dual-credit education to determine overall costs. The overall cost at each individual site was divided by the total number of dual-credit SCHs provided in 2016–17 to determine a site-specific cost per semester credit hour. We focus on the cost per semester credit hour per student, rather than the cost per student, because much of the costs involved in producing dual-credit education, such as the instructor costs, vary with the number of courses, not the number of students. Our estimates of the annual cost per semester credit hour can be converted to annual cost per student simply by multiplying by the average number of semester credit hours that each student takes each year.

Funding Analysis

To incorporate funding into the cost study, we examined the existing policies and state funding formulas determining the amount of funding distributed to community colleges and K–12 school districts. State funding for community colleges is primarily delivered on a per-contact hour basis, with funding rates differing according to the type of course. For K–12 school districts, state funding is largely based on each district's average daily attendance, with adjustments related to district size, geographic location, and student population. However, regardless of whether a student's class schedule includes only traditional high school (nondual-credit) courses or dual-credit courses (taken either on a high school campus or on a college campus), the same amount of state funding is generated, even though there are clear differences in costs associated with these models of instructional delivery.

By understanding the funding formulas in detail, we attempted to calculate the amount of state funding going to both community colleges and K–12 districts on a per SCH or per course basis. We then compared these state funding figures to the costs incurred by community colleges and school districts to understand the magnitude of the difference between costs and state funding, with an understanding that any difference between the two must be made up through other sources.

One additional source of revenue available to community colleges is tuition and fees paid for by either the students or the school districts. We examined the different approaches to charging tuition and fees taken by the community colleges in our sample to understand the impact of this additional revenue source in making up the difference between costs and state funding at the community college level.

Benefits Analysis

Upon completion of the cost analysis—which yielded an estimate of the cost of delivering dual-credit programs—we conducted a benefit-cost analysis to understand whether the benefits of dual-credit outweigh the costs of providing this intervention. To assess benefits, we assigned dollar values associated with the following outcomes measured in the impact analysis: (1) increases in the graduation rates from postsecondary education programs and (2) changes in the time and SCHs taken after high school graduation to complete postsecondary education programs. These positive outcomes provide monetary benefits for both students and the state of Texas.

We can think of benefits both in terms of those that are short term and long term. Short-term benefits for students might include paying less for college, given that students have already earned credits toward college completion while still enrolled in high school. In addition, accelerated college completion results in earlier entry into the workforce, reducing the cost of college and allowing recent graduates to begin earning a full-time salary. This last piece is salient to the student debt goal in 60x30TX because less time in college and earlier entry into the workforce should also decrease student debt. Long-term outcomes accrue from differential earnings over the course of an individual's lifetime. Long-term societal benefits may also include lower levels of criminal activity, reduced use of social welfare or healthcare systems, and higher tax revenues associated with a more educated and higher paid workforce (Trostel, 2009).[19]

Cost of Providing Dual-Credit Courses in Texas

In this section, we describe the results from our cost analysis. As mentioned previously, we sampled five community colleges varying by size, geographic area within the state, and whether they serve a more urban or rural population of students. We then selected a set of school districts partnering with these community colleges of varying size and with varying delivery models. We intended to select two school districts for each community college. However, due to lack of availability or responsiveness, we were unable to gather data for districts partnering with one of the community colleges. However, for two other community colleges we gathered data from three rather than two school districts. In total, we retained a sample of 10 school districts (two districts with two schools each and two districts with three schools each). In reporting our results, we do not identify the community colleges or school districts and have, instead, assigned each college a letter (A-E) and each school district a number along with the letter of the partnering college (e.g., District 1A).

[19] We do not measure these benefits directly as part of this study, but instead apply estimated benefits based on prior research and knowledge on the benefits of increased education.

In addition to being diverse in size and location, the community colleges sampled were also diverse in the method of instructional delivery (Table 4.1). In four of the five community colleges, dual credit was most commonly delivered at the high schools. There was substantial variation across sites in terms of who was teaching the dual-credit courses. In two sites, dual-credit courses were most commonly delivered by high school teachers who were approved to teach dual credit by the community college; in one site, dual credit was overwhelmingly taught by part-time (adjunct) community college faculty; and in two sites dual credit was most commonly delivered by full-time college faculty.

Table 4.1. Sample of Community Colleges

College	Number of Dual-Credit SCHs	Serves Mostly Urban or Rural	Courses Most Commonly Delivered at High School or College Campus	Most Common Faculty Type Teaching Dual Credit	Number of Partnering Districts Included in Study
A	High	Urban	High School	High School Teacher	3
B	High	Urban	High School	Part-Time College	2
C	Moderate	Urban	College	Full-Time College	2
D	High	Rural	High School	High School Teacher	3
E	Moderate	Rural	High School	Full-Time College	0

Notes: High number of dual-credit SCHs is more than 20,000 in 2016–17. Moderate number of dual-credit SCHs is more than 10,000 and less than 20,000.

In addition to this variation across community college sites, there was also variation in how dual credit was delivered across and within the sampled districts. Many of the districts included in the sample operated dual credit in both a traditional manner (for students attending the traditional comprehensive high schools) and as part of ECHS programs. ECHSs are high schools where the goal is for students to earn a two-year degree or certificate while in high school. Therefore, students enrolled in ECHSs take dual-credit courses in far greater numbers and often begin enrolling in dual-credit during the ninth grade. ECHSs are also sometimes located on or near a community college campus. Because of this, ECHS students more often take dual-credit courses on a college campus and are taught by college faculty compared with traditional dual credit. Finally, community colleges often use different tuition agreements for dual-credit in ECHSs versus dual credit for students in traditional comprehensive high schools.

TEA established a blue print for ECHSs that requires, among other things, individualized student plans and ongoing academic support, college readiness advising, and mentorship opportunities, all of which likely require additional support staff. ECHSs are often smaller schools of approximately 450 students with lower administrator-to-student ratios. We use school-level staffing files to calculate the additional staff for ECHSs compared with traditional high schools in the same district and factor this into our cost analysis. In addition, both ECHSs and traditional high schools with substantial numbers of students taking dual-credit not taught by high school teachers are able to reduce teaching staff. Our data show that a typical high school teacher teaches five course sections, each with an average class size of 24 students; therefore, for every 720 SCHs of dual credit taught by college faculty, a high school can hire one less teacher. We factor these cost savings into our estimates of the cost of providing dual-credit opportunities.

In the rest of the chapter we present an overview of the costs for traditional and ECHS dual-credit models, followed by our analysis of statewide costs of dual credit and the cost burden of dual credit. In addition, short narratives describing the salient features of dual credit offered at each college site along with a presentation of costs for each of the community college-school district partnership can be found in Appendix E.

Dual Credit in Traditional Comprehensive High Schools

Costs for delivering traditional dual credit (delivered through traditional comprehensive high schools as opposed to ECHSs) showed substantial variation across the colleges. Several factors emerged as important predictors of differences in the cost of dual credit across sites, including the type of instructor and the size of the school district. Following, we describe the main cost factors contributing to the cost of dual credit in traditional high school settings.

Dual-credit costs vary substantially according to the type of instructor teaching the course.

The first factor impacting dual-credit costs is the type of instructor teaching the course. There are generally three types of teachers for dual-credit courses: full-time college, part-time (adjunct) college, and high school teachers. When college faculty teach courses, the college pays for those faculty. Full-time college faculty are paid substantially more than adjunct college faculty, making full-time college faculty a more expensive option. In addition, when dual-credit courses are taught by college faculty, high schools can reduce the number of teaching staff at their school. During interviews, school district administrators noted the cost savings associated with assigning community college faculty as instructors of dual-credit courses. As one district administrator reported, “If dual credit were to go away, then we would have to absorb those kids back into our system and it would cost us a lot of money to do that. That instruction right now, we would have to

instruct those classes because [students] are counting on almost all of them for graduation requirements." Because districts can reduce teacher staffing levels by assigning college faculty to teach high school classes, we accounted for cost savings on teacher staffing in our estimates.

Conversely, when high school teachers teach dual credit, the college bears little cost for dual-credit instruction. Some colleges (and most school districts) pay small stipends to high school teachers who teach dual credit. In addition, colleges reported costs to the college for training and monitoring high school teachers who teach dual credit. However, these costs are small compared with the salary of a full- or even part-time college instructor. In this case, high schools do not realize any cost savings from outsourcing instruction to the college, causing overall costs to school districts and high schools to be higher when they use their own teachers to deliver dual credit.

In Colleges A and D, the most common type of instructor was a high school teacher. This arrangement for dual credit reduces costs borne by the college. As seen in Table 4.2, College A had the smallest college cost prior to accounting for tuition. However, the school districts associated with these colleges tended to have higher school district costs prior to tuition than school districts associated with the other colleges. College D also had low college costs compared with colleges C and E but larger college costs compared with Colleges A and B. While approximately 57% of dual-credit at college D was delivered by high school teachers, much of the remaining dual credit was delivered by full-time college instructors at College D. Colleges A and B were less than half as likely as college D to use full-time college instructors.

Table 4.2. Average dual-credit costs per semester credit hour to colleges, school districts, and students pre- and post-tuition across five colleges

	College A	College B	College C	College D	College E
College Cost Pre-Tuition	$62.78	$73.83	$122.49	$81.11	$94.33
School District Cost Pre-Tuition	$56.22	($22.89)	$10.52	$46.22	
Student Cost Pre-Tuition	$0.63	$26.03	$11.49	$17.12	
College Cost Post-Tuition	$58.34	$72.16	$89.49	$45.12	$44.33
School District Cost Post-Tuition	$59.23	($22.89)	$23.55	$77.72	
Student Cost Post-Tuition	$0.63	$27.69	$31.46	$21.62	
Total Cost	**$119.63**	**$76.97**	**$144.50**	**$144.45**	

Note: The pre-tuition costs do not account for the tuition payments at each community college. The post-tuition costs do account for tuition charged to dual-credit students. Charging of tuition does not impact the total costs, but shifts the burden of cost away from the college to school districts and students. We did not collect information from school districts about costs for College E, so we could not calculate costs for the school district and student. For more detailed descriptions of costs by college and partnering district, see Appendix A.

College B largely used college faculty rather than high school teachers for dual-credit courses. Most of those college faculty were adjunct, who are substantially less costly to employ. In addition, the school districts partnered with College B receive cost savings from having college faculty teach substantial numbers of its students. For the school districts associated with College B, the cost savings associated with reduced teaching staff were substantially larger than the administrative costs associated with operating dual-credit programs. Therefore, the school districts associated with College B had an overall cost savings of $23 per SCH from students participating in dual credit. Because the use of adjunct teaching staff results in lower costs on the college side compared with full-time college teaching staff and provides school districts with cost savings of having staff other than their own teachers deliver instruction, this arrangement resulted in substantially lower overall costs compared with the other colleges ($77 per SCH compared with $120, $145, and $144 in College A, C, and D, respectively). These results are described in greater detail in Appendix E.

The most common type of instructor for dual-credit courses in Colleges C and E were full-time college faculty. For College C, more than 80% of dual-credit semester credit hours were delivered by full time college faculty, and for College E, a little more than 72% were delivered by full-time college faculty. The college instructional costs at Colleges C and E were substantially higher than the other community colleges sampled, contributing to the higher college costs pretuition observed at these schools. Because dual credit associated with College C is rarely delivered using high school teachers, there were substantial cost savings associated with reduction in numbers of high school teachers, lowering the overall pretuition cost to the school district. This phenomenon is also likely the case in College E, where full-time college faculty teach the majority of dual-credit course; however, we exclude district costs from Table 4.2 because we did not collect interview data on administration and advising costs for school districts partnering with College E. For more detailed descriptions of costs of instructional personnel, see the site-specific narratives found in Appendix E.

Small school districts delivering dual credit had higher school district administrative costs.

A second factor that affected cost differences was the size of the school district. We originally hypothesized that rural dual-credit partnerships might have some additional costs not found in urban partnerships due to differences in scale of operation and having larger distances between high schools and community colleges. We observed some additional costs related to travel in rural areas. For example, the dual-credit coordinators for colleges serving predominately rural school districts described having to drive several hours one-way to visit their high school partners. However, the costs of travel at the rural colleges were quite small compared with the

personnel costs for administering dual credit and the instructional costs. In College D, for example, travel costs for college administrators visiting high schools for outreach visits were less than $0.50 per SCH. Therefore, there was little systematic difference in costs of dual credit for partnerships with urban compared with rural districts.

Additional costs were related to scale on the district administrative side. District administrative costs largely consisted of either central administrative staff or staff at individual high schools involved in coordinating dual-credit delivery between school districts or high schools and the community college partner. Several of the school districts partnering with College D in particular were quite small. These were districts containing only one high school and providing less than 2,000 SCHs of dual-credit instruction per year. In addition, one of the school districts partnering with College C was a small district containing a single high school, while the other was a fairly large urban district. In these single high school districts, the administrative staff on the district side were more likely to be only in the high school rather than central district administrative staff. For both College C and D, the smaller school districts had substantially higher district administrative costs per semester credit hour compared with the larger school districts. Because Table 4.2 reports average costs by community college, differences in cost across larger and smaller districts partnering with the same community college are not apparent within the table. (Appendix E shows costs for individual districts within each partnering community college.)

In addition to administrative staff, districts also had staff involved in advising students related to dual credit. In many cases, traditional high schools had a counselor who was assigned to oversee advising related to dual credit. In some cases, the counselor spent all of their time on dual-credit-related activities, while in other instances counselors devoted only part of their time to dual credit.

Across all school district partners, district and high school administrative and advising costs averaged $55.42 per semester credit hour. Districts delivering at least 3,500 semester credit hours of dual-credit instruction had district and school administrative and advising costs around $46 per SCH, while the same costs for smaller districts were $69 per SCH, a difference of approximately $23 per SCH.

Differences in college administrative costs were not clearly related to college characteristics.

In addition to administration and advising on the school district side, there are also administrative costs on the college side. Each college had someone serving as the director of dual credit (or a similar title) who oversaw all dual-credit and ECHS partnerships for the college.

In most instances this person devoted all their time to dual-credit-related activities. However, in one of the colleges, "partnerships" was defined more broadly, so the person who oversaw dual credit also oversaw other types of partnerships, such as delivering instruction to incarcerated individuals. At each college, there were also one or more dual-credit coordinators who were responsible for maintaining communication with particular district or high school partnerships. Depending on the size of the college and the structure of the administrative team, the number of coordinators varied from one to four.

In addition to staff dedicated to overseeing and administering dual credit, numerous other staff at each college were involved in administering dual credit in some way. These staff included deans, provosts, vice presidents, department chairs, registrars, human resources, and other staff. In most of these cases, however, the amount of staff time devoted to dual credit was relatively small.

The cost of college administration ranged from $23 per SCH to $51 per SCH. Colleges with a greater number of SCHs typically had larger administrative costs overall; however, the differences in college administrative costs *per SCH* did not seem to be related to any readily observable college characteristics. The college with the highest administrative costs was College A, a large urban college. College B, also a large urban college, had college administrative costs of $32 per SCH. Likewise, the cost of college administration in the two rural colleges also were quite different (see Appendix E for additional information about different categories of costs for community colleges).

School districts decide whether to pay for textbooks and testing or whether students pay those costs.

Costs of textbooks amounted to approximately $15 to $25 per SCH. This assumes that community college textbooks must be replaced every 3 years, while textbooks for traditional high school classes have a much longer span of use. None of the community colleges in our sample provided textbooks to students. In each case, school districts decided whether to pay for textbooks themselves or make students responsible for their own textbooks.

Another additional cost of dual credit is student testing. For many dual-credit courses, students must demonstrate they are academically prepared by having a qualifying test score. All of the districts in our sample administered the TSIA for the students in their district. Costs of testing amounted to $2 to $4 per SCH. As with testing, districts decided whether to cover the cost of testing or charge students.

In addition to textbooks and testing, another moderately large nonpersonnel cost for school districts is the cost of providing bus service to get students from the high school to the community college when classes are taken on the college campus. Depending on the number of trips to and from campus and the distance to campus, bus service for students at the sites offering this service ranged from $5 to $20 per SCH.

Due to textbook and testing costs, the average cost of dual credit to students prior to any tuition and fees was almost $13 per SCH. The cost of textbooks, testing, and student transportation for school districts amounted to $17 per SCH on average. While some districts covered the cost of TSIA and textbooks, we found that students paid for these items in most districts in our sample.

Charging tuition shifts the cost of dual credit away from colleges to school districts and students.

The tuition arrangements across the community colleges in our sample varied substantially. These different tuition arrangements do not affect the total cost but shift the burden of the cost from colleges to school districts and students when tuition or fees are charged. In Colleges A and B, tuition is largely waived. In College A, districts pay tuition for courses taught by college faculty, but this delivery mode is rare outside of ECHSs. In College B, tuition and fees are not waived for a limited number of courses, and a flat fee of $100 is charged per course for ECHS students, but the college waives tuition for the majority of dual credit. Because minimal tuition and fees are charged for dual credit at these colleges, the cost burden shifts little when accounting for tuition and fees.

In College C and E, a reduced tuition and fee amount is charged for dual-credit students. In one of the partnering districts with College C, the district pays for this fee only for ECHS students and any student eligible for free or reduced-price lunch. This means the bulk of the fee is paid for by the district. In the other district partnering with College C, students pay for the fee, shifting a substantial share of the burden to students.

College D has an interesting arrangement for charging tuition and fees. Rather than charge districts or students on a per credit hour basis, the college allows districts to buy entire course sections. So, the districts pay for sections of courses if they have enough students to fill an entire section. For courses taken outside of those sections paid for by the district, students are charged 85% of the tuition cost. In each of the colleges that charge some amount of tuition and fees, the cost burden for the colleges is substantially reduced while the burden for districts and students increases.

ECHS Dual Credit

Although state law requires that dual-credit education be available in all Texas high schools, a substantial number of students access dual-credit coursework by enrolling in an ECHS.[20] ECHSs are typically small high schools, enrolling on average approximately 450 students and providing students with the opportunity to complete 60 SCHs leading to an associate's degree. ECHSs generally follow one of two models. Stand-alone ECHSs are located on community college campuses and consists of buildings designed to hold just the ECHS students. A growing number of ECHSs are designed as a school-within-school model, in which the ECHS is a program that exists in a larger comprehensive high school. Districts often have separate MOUs for ECHSs that require different staffing patterns or tuition agreements. As such, we calculate the annual per-SCH cost of dual-credit education in ECHSs separately.

Costs per SCH of college and school district administrative are similar for dual credit delivered through ECHSs and traditional high schools.

Interview data show that both community college and school district central office staff generally have similar staffing allocations for ECHSs as for dual-credit in traditional high schools. Administrators reported spending more of their time overseeing dual-credit education in ECHSs; however, data show that ECHSs have a greater number of SCHs per student. In short, while ECHSs require more administrator staff time *per student*, ECHS students receive a greater number of SCHs on average, compared with students in traditional comprehensive high schools. Therefore, the cost per SCH for community college and school district central office staffing is similar in ECHSs and in non-ECHS traditional high schools.

Costs of school-level administrative and support staff are greater at ECHSs compared with traditional high schools.

ECHSs have a fundamentally different approach to assigning instructional and noninstructional personnel at the school level. For example, stand-alone ECHSs that are located on community college campuses make it easy for students to enroll in courses at the community college because students can simply walk to the community college campus from their high school. As noted earlier, courses taught by community college faculty shift the cost of educating high school students from school districts to community colleges. In school-within-school models, because a large number of students are interested in pursuing dual-credit coursework, districts

[20] HB 1 (2006) requires school districts to implement a program providing students the opportunity to earn at least 12 college semester credit hours through advanced placement, dual credit, or advanced technical credit courses, which may include locally articulated courses (79th Texas Legislature, 3rd Called Special Session, 2005).

often provide bus transportation to nearby community college campuses so that students can take dual-credit courses on the community college campus. In both cases, the amount of cost savings from reduced teacher staffing is significantly larger compared with dual-credit education in traditional high schools. School districts also design different staffing models for ECHSs, often providing additional support staff and counselors and other support staff. In addition, because ECHSs are smaller high schools, the staffing allocation often includes a greater number of administrators per student.

We estimate the cost savings for reduced teacher staffing at ECHSs using similar methods to those described earlier. Data show that 85% of dual-credit courses in ECHSs are taught by community college faculty, compared with 71% in non-ECHS traditional high schools. In other words, in non-ECHS traditional high schools, high school teachers are twice as likely to be the instructor of record for a dual-credit course compared with ECHSs (29% compared with 15%). Most of the difference results from a greater proportion of full-time community college faculty teaching dual-credit, as opposed to part time. In ECHSs, 55% of SCHs are delivered by full-time college staff, and 29% are delivered by part-time college staff, compared with 42% and 29%, respectively, in non-ECHS traditional high schools. The cost savings for school districts associated with reduced teacher staffing in ECHSs is $76 per SCH, compared with $60 per SCH in non-ECHSs, on average statewide.

To estimate the additional costs associated with alternate staffing models, we draw on TEA data that include information about the number of support staff and administrators at each school in Texas. We compare the staffing ratios of ECHS to non-ECHS traditional high schools in the same district. We focus on high schools in the same district, rather than comparing all ECHSs across the state to all non-ECHSs to account for possible differences in overall staffing ratios across districts. For example, if districts that have at least one ECHS generally provide more staff per student in all high schools, compared with districts that do not have an ECHS, then our results would show greater staffing levels in ECHSs. Among districts with at least one ECHS and at least one non-ECHS, we find that ECHSs have 0.49 full-time equivalent (FTE) more support staff and 0.48 FTE administrators per 100 students.[21] Greater staffing ratios result in

[21] As with all of our findings reported as state averages, these figures omit significant variation across contexts. For example, the stand-alone ECHS in District A1 has 0.75 FTE more support staff for each 100 students, but 0.35 FTE fewer administrators per 100 students. In contrast, the ECHS in District A3 has 1.09 FTE fewer support staff per 100 students, but 0.63 FTE more administrators for each 100 students. ECHSs employ far fewer educational aides (many do not hire any educational aides) but are less likely to serve English language learners or students in special education, and we therefore omit these cost savings. Note that we are unable to make within-district comparisons of staffing ratios between ECHSs and non-ECHSs for districts with no ECHS, such as District B2, or those in which all high schools are classified as ECHSs.

additional annual costs for dual credit in ECHSs that amount to $2.46 for support staff and $6.68 for administrators, respectively, for a total of $9.14 per SCH.

Overall costs for ECHSs and traditional dual-credit models are relatively similar, but colleges bear more of the cost in ECHSs.

In summary, ECHSs affect dual-credit education resource allocation by both increasing the overall costs and by shifting the costs to community colleges. These shifts happen because of differences in the instructor assigned to teach the dual-credit course and because of differences in staffing patterns in ECHSs. For dual-credit delivered in ECHSs, school districts and community colleges pay 2.0% and 86.3% of the costs, respectively, whereas in non-ECHS traditional high schools, those figures are 14.3% and 74.1%, respectively, prior to accounting for any tuition arrangements. However, the overall average statewide costs of dual credit delivered in ECHS compared with traditional high schools are relatively similar: $110 compared with $111 per SCH, respectively. This is because the cost savings related to reduced dependence on high school teachers largely offsets the additional costs of support staff and administrators.

Statewide Costs and the Distribution of the Cost Burden of Dual Credit

Based on average costs calculated across the five colleges and 10 school district partners, we extrapolated the costs of dual credit statewide, as shown in Table 4.3. This consisted of calculating the percentage of teaching staff who were full-time college, part-time college, or high school teachers for each partnership between a community college and high school. We applied an average instructional cost for each type of teaching arrangement, with full-time college instructors being the most expensive and high school teachers being the least expensive. We then calculated the high school teacher cost savings associated with classes being taught by full- or part-time college instructors for each partnership for traditional dual-credit models. We also calculated the cost savings of reduced staffing needs for ECHSs. To these costs, we applied average community college and school district administrative and advising costs, and other district and students costs for non-administrative costs such as textbooks, testing, and bus transportation. Because district administrative costs varied by district size in our sample of districts, we also applied an additional administrative cost for districts providing less than 3,500 SCHs of dual credit. Lastly, because we used statewide average prices to calculate our costs at each college, to account for geographic variation in prices across the state, we applied a geographic cost adjustment using the Comparable Wage Index (Taylor, Glander, & Fowler, 2006).

Table 4.3. Average Costs by Cost Category Used in the Calculation of Statewide Costs, Not Accounting for Tuition

Cost Category	Average Cost per SCH
Type of Instructor	
Full-Time College Teacher	$87.56
Part-Time College Teacher	$35.03
High School Teacher	$14.29
College Administration and Advising	$38.51
District and High School Administration and Advising	$46.39
Size of School District	
Small District (<3,500 SCH)	$22.58
District and High School Other Costs	$17.48
Costs to Students	$12.83
ECHS versus dual-credit in non-ECHS high school	
ECHS High School Staffing Adjustment	$9.14

Note: The costs noted here do not add up to the total cost per SCH. Each course will either be taught by a full-time college, part-time college, or high school teacher. Only eligible districts and schools will receive the small district additional cost or the ECHS high school staffing adjustment. Additionally, this table does not include savings to school districts when dual-credit courses are taught by college faculty. These savings depend on the proportion of dual credit taught by college faculty as opposed to high school teachers.

Statewide, the cost of dual credit is $111 per SCH; colleges bear 77% of the cost prior to any tuition and fee arrangements.

Statewide, we calculate an overall cost per SCH of $111. Table 4.4 displays the estimated average cost per semester credit hour according to various categories of costs, by stakeholder. Comparing this table to Table 4.3, there are some clear differences. The costs for staff in Table 4.4 are all less than identified in Table 4.3 because the staff costs in Table 4.3 are the full cost of a teacher of that type per semester credit hour for a given course. The staff costs in Table 4.4 represent the average statewide so the cost of each staff type is multiplied by the share of semester credit hours delivered by that staff type. For example, when a full-time college faculty member teaches a course, the average instructor cost per semester credit hour for that course is $87.56; however, only 41% of dual-credit semester credit hours are delivered by full time college faculty. Therefore, the average statewide cost from full time college faculty instructors is $35.52.

The full cost for the small district administrative cost and the ECHS adjustment is also not applied in Table 4.4 because not all semester credit hours are delivered to students in small districts or students in ECHS settings. The remaining costs are close to those reported in Table

4.3. Any differences are due to the application of a geographic cost adjustment, which adjust the costs in Table 4.3 based on the labor market in which the student attends high school.

Table 4.4. Average Statewide Costs by Cost Category and by Stakeholder, Not Accounting for Tuition

Cost Category	Average Statewide Cost per SCH
Costs to Community College	
Full-Time College Teacher	$35.52
Part-Time College Teacher	$9.43
High School Teacher	$3.94
College Administration and Advising	$36.62
Costs to School District	
District and High School Administration and Advising	$44.11
Small District Additional Administration Cost	$10.01
District and High School Other Costs	$16.62
High School Teacher Cost Savings	-$60.86
ECHS High School Staffing Adjustment	$2.34
Costs to Students	$12.83
Overall Cost	**$110.57**

In addition to calculating pre-tuition average costs, we applied some typical tuition arrangements to examine how tuition arrangements, if applied statewide, would shift the cost burden of dual-credit. Across districts and community colleges in our study, two colleges waived tuition and fees, and tuition and fees in the remaining colleges ranged from $22 to $50 per SCH. The first tuition arrangement was that all tuition and fees were waived. The next three tuition arrangements assumed that the college charged $40 per SCH in tuition and fees—an amount within the range of tuition and fees represented in our sample. In the second scenario, the district pays the entire tuition amount; in the third scenario, the student pays the entire amount, and in the fourth, the cost is split evenly between the district and student.

When tuition is waived completely, 77% of the overall burden of dual credit ($86 per SCH) is borne by the community colleges, 11% is borne by school districts ($12 per SCH), and 12% is borne by students ($13 per SCH). When $40 of tuition and fees is charged per SCH, the cost to colleges is reduced substantially and community colleges end up paying 41% of the overall cost for dual credit.

When colleges charge tuition, districts can choose whether to cover that cost out of the district budget in full, in part, or not at all. Any amount of tuition and fees not covered by the district must be paid by students and their families. In the three scenarios where $40 of tuition and fees is charged per SCH, the amount of tuition and fees represents 36% of the overall cost of dual-credit instruction. Tuition and fees represent a transfer of cost away from the college to districts or students. In the case where the district pays the full tuition amount, the cost to districts increases from $12 per SCH to $52 per SCH, increasing the share of dual-credit paid for by the district from 11% to 47%.

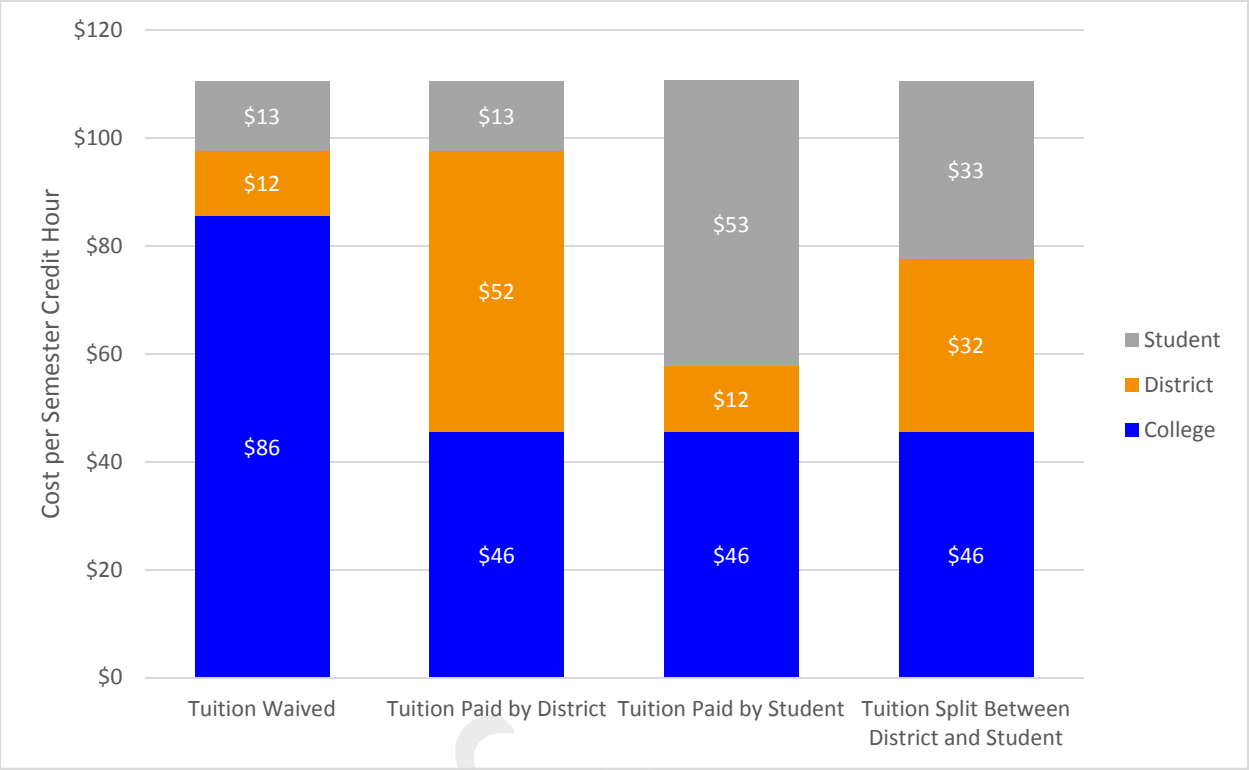
Alternatively, the district could choose to not pay for tuition and fees. In this scenario the entire tuition amount is paid for by students and their families, increasing the cost to students from $13 to $53 per SCH, and increasing the share of dual-credit paid for by students from 12% to 48%. Lastly, the district could choose to partially pay for dual-credit. In the case of one of our sampled districts, the district paid for dual credit only for students who were eligible for free or reduced-price lunch. In another district, the district purchased blocks of commonly taken dual-credit courses, but if students wanted to take a course outside of those common courses, the students had to pay. In many partnerships, districts and students share the costs of dual-credit tuition and fees. To model this scenario, we assumed the district paid for half. As shown in the column furthest to the right in Table 4.5, the increased cost burden for dual-credit was shared equally between districts and students when the tuition is equally shared (districts pay 29% of the costs and students pay 30%). The distribution of costs across colleges, school districts, and students according to various tuition arrangement scenarios is also shown in Figure 4.1.

Table 4.5. Statewide Costs per SCH and Total Costs

	Tuition Waived		Tuition Paid by District		Tuition Paid by Student		Tuition Split Between District and Student	
College Costs per SCH	$86	77.3%	$46	41.2%	$46	41.2%	$46	41.2%
District Costs per SCH	$12	11.1%	$52	47.2%	$12	11.1%	$32	29.1%
Student Costs per SCH	$13	11.6%	$13	11.6%	$53	47.8%	$33	29.7%
Overall Costs per SCH	**$111**		**$111**		**$111**		**$111**	
College Total Costs	$94,107,160		$50,086,440		$50,086,440		$50,086,440	
District Total Costs	$13,455,302		$57,476,024		$13,455,302		$35,465,664	
Student Total Costs	$14,119,646		$14,119,646		$58,140,368		$36,130,008	
Overall Total Costs	**$121,682,108**		**$121,682,110**		**$121,682,110**		**$121,682,112**	

Note: The total costs are estimates based on 1,100,518 SCHs delivered in Texas in 2016–17.

Figure 4.1. Distribution of Average Costs Across Colleges, Districts, and Students by Tuition Scenario



Total estimated costs of dual-credit in 2016–17 were more than $121 million statewide.

When examining estimated total costs, rather than costs per SCH, we can see that these changes in tuition and fee arrangements have large implications for the dollars being contributed to dual-credit education by colleges, school districts, and students. In total, dual-credit in 2016–17 cost more than $121 million statewide.[22] If tuition and fees were waived statewide, colleges would pay approximately $94 million of the total, while districts would pay $13 million, and students would pay $14 million. Charging $40 of tuition and fees per SCH statewide would result in a shift of $44 million away from colleges to districts and students.

[22] This is based on the amount of semester credit hours provided for each dual credit partnerships. Because of data privacy issues, small partnerships serving less than 5 dual credit students were not included in the data we received. Therefore, this represents a slight underestimate of the cost of dual credit statewide.

Costs per SCH and who bears the cost of dual credit vary substantially according to the type of dual-credit instructor.

As mentioned previously, the factor that seemed most predictive of costs, and who bears the costs, is who is teaching the courses. In Table 4.6, we show our estimates of average costs for partnerships where more than 75% of dual-credit instruction is taught by full-time college instructors, part-time college instructors, or high school instructors. Based on these estimates, who teaches the course has substantial implications for overall cost of dual credit and who bears the cost. In the tuition waived scenario, when full-time college instructors teach more than 75% of dual credit, the overall cost per SCH is $109 with colleges picking up 98% of the overall cost. Charging $40 in tuition and fees reduces college costs to $67 or 61% of the overall cost, shifting the cost to districts and students.

Having part-time college teachers as the primary dual-credit instructors is the least costly scenario at only $82 per dual-credit SCH. In this scenario, with tuition waived, colleges still pick up the bulk of the cost. However, given the smaller overall cost, charging tuition and fees reduces college costs to only $34 per SCH, or 42% of the overall cost. In both cases where instruction occurs primarily through full-time or part-time college staff, school districts receive a cost savings of not having their own instructional staff teach students for the time they are in dual-credit courses. When instruction is primarily delivered by college faculty the cost to districts, when not charging tuition, is negative. This means, school districts save money by participating in dual credit when teachers other than high school teachers are delivering the instruction. Several community colleges in our study have accounted for the differential cost burden by charging a fee when college instructors teach dual credit, but waiving fees when dual credit is taught by a high school teacher.

In the case of high school instructors teaching dual credit, the overall cost per SCH is $126 dollars, with school district bearing the most cost at $60 per SCH, or 48% of the overall cost, and colleges paying $53 per SCH (42%). If, in this case, $40 in tuition and fees were assessed to school districts, school districts would end up paying almost 80% of the cost of dual credit, with colleges only paying 10% of the cost. In this case, it does not seem like charging the full amount of tuition and fees would be reasonable. In fact, at several of the community colleges we interviewed, discounted rates for dual-credit courses were provided when classes were taught by high school instructors. This is also evident in many MOUs between colleges and school districts regarding the provision of dual-credit instruction.

Table 4.6. Average Costs per SCH According to Predominant Instructor Type

	Tuition Waived		Tuition Paid by District		Tuition Paid by Student		Tuition Split Between District and Student	
Partnerships with more than 75% Full-Time College Instructors								
College Costs per SCH	$107	98.2%	$67	61.3%	$67	61.3%	$67	61.3%
District Costs per SCH	–$11	–10.0%	$29	26.8%	–$11	–10.0%	$9	8.4%
Student Costs per SCH	$13	11.8%	$13	11.8%	$53	48.6%	$33	30.2%
Overall Costs per SCH	**$109**		**$109**		**$109**		**$109**	
Partnerships with more than 75% Part-Time College Instructors								
College Costs per SCH	$74	90.4%	$34	41.5%	$34	41.5%	$34	41.5%
District Costs per SCH	–$5	–6.1%	$35	42.8%	–$5	–6.1%	$15	18.3%
Student Costs per SCH	$13	15.7%	$13	15.7%	$53	64.6%	$33	40.1%
Overall Costs per SCH	$82		$82		$82		$82	
Partnerships with more than 75% High School Instructors								
College Costs per SCH	$53	42.2%	$13	10.4%	$13	10.4%	$13	10.4%
District Costs per SCH	$60	47.6%	$100	79.4%	$60	47.6%	$80	63.5%
Student Costs per SCH	$13	10.2%	$13	10.2%	$53	42.0%	$33	26.1%
Overall Costs per SCH	**$126**		**$126**		**$126**		**$126**	

Note: Partnerships with more than 75% of SCHs delivered by full-time college instructors, delivered 249,588 SCHs, representing 22.7% of all dual credit. Partnerships with more than 75% of SCHs delivered by part-time college instructors delivered 64,231 SCHs, representing 5.8% of all dual credit. Partnerships with more than 75% of SCHs delivered by high school teachers delivered 128,767 SCHs, representing 11.7% of all dual credit.

While costs of dual credit are similar in traditional and ECHS partnerships, the college bears more cost in ECHS partnerships.

When examining the estimated costs of Early Colleges compared with traditional partnerships, students attending ECHSs take more dual-credit course compared with students in traditional high schools, so dual-credit delivery at ECHSs is more resource intensive on a per-student basis, but there is relatively little difference, on average, in costs per SCH. Traditional models, on

average, have slightly lower college costs, but higher district costs per SCH compared with Early Colleges. This is the result of Early Colleges being less likely to use high school teachers to deliver dual credit, generating additional costs for colleges and cost savings from reduced teaching staff for high schools.

Table 4.7. Average Costs per SCH According to Predominant Instructor Type

	Tuition Waived		Tuition Paid by District		Tuition Paid by Student		Tuition Split Between District and Student	
Traditional (non-ECHS) Partnerships								
College Costs per SCH	$82	74.1%	$42	37.9%	$42	37.9%	$42	37.9%
District Costs per SCH	$16	14.3%	$56	50.5%	$16	14.3%	$36	32.4%
Student Costs per SCH	$13	11.6%	$13	11.6%	$53	47.7%	$33	29.7%
Overall Costs per SCH	**$111**		**$111**		**$111**		**$111**	
ECHS Partnerships								
College Costs per SCH	$95	86.3%	$55	50.0%	$55	50.0%	$55	50.0%
District Costs per SCH	$2	2.0%	$42	38.3%	$2	2.0%	$22	20.2%
Student Costs per SCH	$13	11.6%	$13	11.6%	$53	47.9%	$33	29.8%
Overall Costs per SCH	**$110**		**$110**		**$110**		**$110**	

Note: Partnerships with more than 75% of SCHs delivered by full-time college instructors delivered 249,588 SCHs, representing 22.7% of all dual credit. Partnerships with more than 75% of SCHs delivered by part-time college instructors delivered 64,231 SCHs, representing 5.8% of all dual credit. Partnerships with more than 75% of SCHs delivered by high school teachers delivered 128,767 SCHs, representing 11.7% of all dual credit.

Funding for School Districts and Community Colleges

Funding for School Districts

Texas uses a foundation formula as the primary method for allocating funding across school districts, known as the Foundation School Program (FSP). The FSP has two main components—operations funding and facilities funding. For the purposes of this study, we focus on operations funding because this is the funding intended to cover the ongoing expenses school districts face in providing instruction to students (TEA, 2017).

The operations component of the FSP operates through two formulas, called Tier I and Tier II. Tier I provides schools with a basic level of funding, allotting schools districts funding for the regular education program, as well as for programs related to student needs, such as special education, CTE, English learner education, compensatory education, and several others. Tier II consists of supplemental funding provided to districts who set higher tax rates than the minimum required to receive Tier I funding.

Each district's enrollment size, student characteristics, and local tax rates determine the district's per-student funding level. The per-student funding level is multiplied by the average daily attendance, or the total number of students in attendance for each instructional day divided by the number of instructional days in the district, to determine each district's total funding level.

School districts do not receive any additional state funding for students taking dual-credit courses.

In total, Tier I FSP funding provides approximately $7,400 per student, with slightly less than half provided by the state and slightly more than half coming from local revenue.[23] As such, an average high school student, taking seven courses per semester over a year, is funded at a rate of approximately $530 per semester-long class (or $177 per semester hour equivalent assuming a class equals three SCHs). Students who enroll in dual-credit courses, regardless of whether the courses take place on a high school campus or a community college campus, count toward a district's average daily attendance. In other words, districts receive the same level of funding per student regardless of the number of students who enroll in dual credit. Because school districts would be funded at the same levels in the absence of dual credit, the marginal funding from students taking dual-credit courses is $0.

Funding for Community Colleges

Community colleges are funded by the state on a per contact hour basis. As a rule of thumb, one SCH equates to 16 contact hours. On a yearly basis community colleges report to the THECB the expenses per contact hour of various types of courses. The state then determines the percentage of contact hour expense they can cover based on the available budget and funds community colleges at a rate equivalent to the average reported expense per contact hour multiplied by the percentage of contact hour expenses funded by the state. Funding rates for 2016–17 varied from $2.21 per contact hour for psychology, social sciences, and history

[23] Calculations made using the *Statewide Summary of Finances Report* for the 2016–17 school year. https://tealprod.tea.state.tx.us/fsp/Reports/ReportSelection.aspx

courses to $9.41 per contact hour for career pilot courses. In general, CTE courses, such as those for health occupations, had higher funding per contact hour with funding rates in the $3 to $5 per contact hour range, while academic courses such as English, mathematics, and sciences generally had funding rates around $2.40 to $2.50 per contact hour.

Community colleges receive approximately $38 per SCH for academic dual-credit instruction.

Because our focus for the cost analysis is on academic courses, we assume an average funding rate of $2.40 per contact hour. Based on the rule of thumb of 16 contact hours per SCH, community colleges are funded at a rate of $38.40 per SCH for academic dual-credit courses. This rate is the same regardless of whether a student is a dual-credit student or a traditional college student. If dual-credit opportunities were not available to high school students, those students would not attend the community college as dual-credit students. Therefore, the marginal funding for each dual-credit SCH is the full funding amount per SCH of $38.40.

Comparison of Funding and Costs

State funding provided to colleges does not cover the costs to colleges when tuition is waived.

As described in the section on costs, on average, when tuition is waived completely, the cost to colleges is approximately $86 per SCH, the cost to districts is approximately $12 per SCH, and the cost to students is approximately $13 per SCH. Given that community colleges receive approximately $38 per SCH in state funding per dual-credit SCH delivered, the remaining cost for colleges is approximately $47 per SCH. This amounts to $51.8 million statewide, when the cost per SCH is multiplied by the total number of dual-credit SCHs delivered. This is much higher than the cost burden to districts and students ($13.5 million and $14.1 million, respectively).

For colleges, the remaining deficit of $51.8 million must be made up through other revenue sources. The most common revenue sources available would be local funding and charging tuition and fees for dual credit. As previously discussed, when colleges charge tuition, it usually ranges from around $25 to $50 per SCH. In this case, any tuition less than $47 per SCH would result in a remaining cost that would have to be funded through tuition from non-dual-credit students or revenue from local taxes.

Because school districts do not receive additional funding for dual credit, they must cover dual-credit costs from existing revenue sources.

In contrast to colleges, school districts do not receive additional funding from providing dual-credit instruction. Therefore, any costs related to dual credit must be covered from their existing revenue sources. Because the costs of dual credit for school districts vary substantially

depending on the arrangement of dual-credit instruction, in some cases it may make sense to charge some amount of tuition and fees to school districts. In particular, when dual credit is largely delivered by college faculty rather than high school teachers, the burden to the college increases, and the burden on school districts decreases. In many cases, districts actually save money through this arrangement due to reductions in teaching staff. In these cases, it would make sense to charge some tuition to districts to even out the cost burden. However, when high school teachers teach dual credit, more of the cost burden shifts from the school district to the college. Therefore, in these circumstances, charging the school districts tuition would only exacerbate the already increased burden of dual credit placed on districts.

Benefits of Dual-Credit Course Taking

The analysis of the impacts of taking dual-credit courses on outcomes shows several statistically significant impacts. We separate the outcomes into two types. The first type are outcomes that have immediate impacts on how much is being spent on higher education by students and their families or by public dollars supporting higher education. These outcomes include the total number of credits completed to earn a four-year degree, the number of college credits needed after completing high school to earn a four-year degree, and the amount of time after high school required to complete a four-year degree. The benefits related to these outcomes can be calculated through extant data on college spending per student and short-term earnings information on the wage rate of a typical college graduate entering the workforce. Furthermore, these benefits are limited to the 4 to 6 years when a student would typically be enrolled in college after completing high school.

Table 4.8 displays the effects of dual credit on these outcomes. As shown, taking dual credit actually increases the total number of credits to degree for a typical dual-credit student. However, each dual-credit student took almost eight fewer credits after high school to earn a college degree compared with non-dual-credit students. This indicates that the increase in overall credit to degree is largely in the form of dual-credit courses and that there may be some inefficiency in dual-credit course taking, where not all dual-credit courses count toward the completion of a four-year degree. Lastly, a typical student who took dual credit and went on to complete a four-year degree was able to graduate in slightly less time than students who did not take dual-credit and completed a four-year degree. This time amounts to more than one month per student. Alternatively, this could be thought of as one of 12 dual-credit students finishing a year earlier.

Table 4.8. Effects of Dual-Credit Course Taking on Credits and Time to Degree

Outcome	Effect	Interpretation
Credit to degree	4.2 more credits per dual-credit student	Each dual-credit student completing a four-year college degree took four more credits in total.
Credit in college to degree	7.8 fewer credits after high school completion per dual-credit student	Each dual-credit student took almost eight fewer credits after high school to earn a college degree compared with non-dual-credit students.
Time to degree	1.0 fewer months to degree after high school completion of those who completed	1 out of 12 dual-credit students finished a year earlier compared with non-dual-credit students.

The second type are outcomes related to increased enrollment in two- or four-year colleges and completion of two- or four-year colleges. In contrast to the previous outcomes, which have only short-term benefits relating to credits and time to degree completion, the benefits of enrolling in and completing a two- or four-year college education accrue over a life time. McMahon (2009) categorizes the benefits of higher education into three types:

- Private market benefits: The increased benefits in the form of higher earnings to those who completed more years of higher education
- Private nonmarket benefits: The increased benefits, such as better health, to those who completed more years of higher education in all forms other than earnings
- Social benefits: The benefits to society from having more educated citizens

We will adopt this framework for accounting for the benefits of dual credit related to enrolling in and completing higher education.

The research team examined numerous outcomes related to enrolling in and completing higher education; however, many of the outcomes are strongly related or interdependent on one another. Therefore, for the purposes of the benefits analysis we focus on one outcome. Results from the impact study indicate that students who took dual credit are 2.2% more likely to complete a two-year certification or degree. In other words, slightly more than two out of 100 students completed at least 2 years of higher education who would not have done so if they were not able to take dual-credit classes in high school.

All other outcomes examined related to long-term academic outcomes were positive, but many were not statistically significant. The absence of any negative outcomes means that the increase in two-year credentials did not displace other outcomes. In other words, the increase in two-year credentials came from the pool of students who would not have obtained any higher-education credentials because there was no decrease in the likelihood of students completing a four-year degree.

Calculation of Benefits

Following we present our calculation of benefits. All benefits presented here are converted to net present value 2017 dollars. One caveat for the benefits calculations and the subsequent comparisons of costs to benefits is that these benefits calculations are based on dual credit that was delivered from 2001 to 2014, while our cost estimates are based on the 2016–17 school year.[24] As mentioned previously, dual-credit instruction has changed rapidly over the past decade. If the impact estimates measured from these years do not accurately depict the impact of dual-credit in 2016–17, there will be misalignment between our estimated benefits and costs.

Time to a Four-Year Degree

As mentioned previously, the results from the impact analysis indicate that dual-credit students take more overall credits (due to inefficiency in dual-credit courses counting toward a degree); however, dual-credit students end up taking fewer college courses after high school completion and complete a four-year college degree in less time compared with students who did not take any dual-credit courses in high school. Any costs associated with the additional courses taken as dual-credit courses during high school are captured by our cost estimates of dual credit. Thus, our benefits analysis must still account for the reduction of credits after high school and decreased time to degree. Because time to degree should be dependent on credits earned, we chose to focus our benefits calculation on time to degree.

Benefits from graduating a year earlier include reduced tuition and fees, costs of books and supplies, as well an additional year of earnings from entering the workforce earlier.

We started by determining the benefits of reducing by one year the time required to complete a four-year degree. For simplicity, we focus first on the benefits of reducing time to degree by one year, and then adjust these figures to the point estimates from the impact study. On average, Texas four-year public colleges spent $17,148 per full-time equivalent student.[25]

[24] Impacts for two-year college outcomes are based on cohorts of juniors from 2001 to 2013. Impacts on time to degree are based on cohorts of juniors from 2001 to 2008.

[25] Calculated using data from the National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS) for public four-year colleges in Texas.

Students bear some of this cost in the form of tuition and fees. Average yearly tuition and fees for these schools amounted to $8,379 (just under half of overall spending). In addition, students on average paid $1,150 in books and supplies. Therefore, the benefits of not paying for one more year of college are split fairly evenly across the students who must pay tuition and buy textbooks and supplies and the taxpayers who fund the remaining cost of college.

In addition to spending less on college, a student who graduates earlier can enter the workforce earlier. According to a survey from the National Association of Colleges and Employers (2017), the average starting salary for a recent bachelor's degree graduate of the class of 2017 was $51,022. Therefore, students who graduate a year earlier potentially earn an extra $51,022 in the year they would have spent in college had they not graduated a year earlier. We make the assumption that 80% of this salary would be take-home pay and 20% would be tax revenue.

Converted to net present value, the overall benefit of graduating one year earlier is approximately $61,590, with $44,732 benefiting the student directly and $16,858 benefiting the public. However, the impact estimate indicates that dual-credit students spend about one twelfth of a year less in school rather than a full year. Additionally, because this outcome was measured only for students who went on to complete a four-year degree, it only applies to approximately 25% of students. Therefore, the average benefit per dual-credit student resulting from less time to completion is about $898 in personal benefits, $338 in public benefits, and $1,236 overall, for a student who takes at least one dual-credit course, compared with a student who does not take any. Because dual-credit students on average complete approximately 9.5 SCHs during high school, the overall benefits on a per SCH basis amount to $131, as shown in Table 4.9.

Table 4.9. Benefits Attributed to Dual-Credit Enrollment Resulting From Reduced Time to Degree

	Benefits of Graduating 1 Year Earlier	Benefits per Student Attributed to Dual-Credit Enrollment	Benefits per SCH
Student	$44,732	$898	$95
Public	$16,858	$338	$36
Overall	$61,590	$1,236	$131

Note: The "benefits of graduating 1 year earlier" are the total benefits of a single student graduating 1 year earlier. The "benefits per student attributed to dual-credit enrollment" are the total benefits shown in the first column multiplied by the impact of less time to completion for four-year graduates (0.102 fewer years) and the proportion of dual-credit students this impact applies to (0.25). The "benefits per SCH" are the benefits attributed to dual credit divided by 9.5 (the average number of SCHs taken by dual-credit students).

Lifetime Benefits of Completing a Two-Year Degree

In addition to the short-term benefits resulting from finishing a four-year degree sooner, students participating in dual-credit courses as high school students were also 2.2% more likely to receive a two-year credential and were as likely to have graduated from a four-year college. This indicates an overall increase in higher education for dual-credit students, resulting from increased completion of two-year credentials. Increased education as a result of taking higher education classes results in a host of benefits that accrue over an individual's lifetime.

McMahon (2009) calculates the benefits of higher education in three buckets: private market benefits, private nonmarket benefits, and social benefits. McMahon argues that the benefits from higher education are due to the increased human capital gained from taking higher education classes and argues against the notion that a diploma simply identifies individuals with higher ability (who would have that higher ability whether they completed any higher education or not). Based on human capital theory, the more time engaged in higher education the more productive individuals should be, regardless of whether they obtained a degree or not. However, many of the previously calculated benefits of higher education compare individuals based on their terminal degrees, bachelor's graduates compared with high school graduates for example.

Workers with associate's degrees earn between $145,000 and $348,000 more than those with only high school diplomas over their lifetime.

McMahon (2009) estimates an average yearly private market benefit of $8,220 (in 2017 dollars) for each year of higher education completed. Assuming those who complete a two-year credential have 2 additional years of higher education compared with those who did not, and assuming a career lasts 40 years (age 25 to 65), this amounts to $347,746 in net present value private market benefits for each student obtaining an additional 2 years of higher education.

Several alternative estimates to private market benefits are slightly more conservative. Hershbein and Kearney (2014) estimate that individuals with associate's degrees earn almost $284,000 more than individuals with high school diplomas. Agan (2014) estimates that individuals with AA degrees earn almost $145,000 more than high school graduates.[26]

[26] The estimates in Agan (2014) are particularly conservative because only 30 years after turning 18 are included in these calculations. Workers typically work much longer.

Private nonmarket benefits, such as improved health and longevity, may be worth more than the increase in earnings.

While many studies of benefits of higher education stop at the private market benefits, McMahon (2009) argues that the private nonmarket benefits are as large or larger than the private market benefits. The private nonmarket benefits included in McMahon's overall calculation include improvement in one's own health, living a longer life, improvement in health of individual's children, better education and cognitive development for individual's children, better spousal health, better management of family size (fewer children), and better consumer choices and ability to save money. In addition, McMahon argues that additional benefits that could not be easily assigned dollar values include happiness, job location and amenities, and lifelong learning. Based on McMahon's calculations, the private nonmarket benefits of higher education are more than 20% greater than the private market benefits. Based on these calculations, total lifetime private nonmarket benefits of 2 years of higher education amount to more than $425,000 per student. This figure is shown in Panel A of Table 4.10 as a private, non-market benefit for students.

Table 4.10. Lifetime Benefits of a Two-Year Credential

	Benefits of 2 Years of Higher Education	Benefits per Student Attributed to Dual-Credit Enrollment	Benefits per SCH
Panel A. Estimates from McMahon, 2009			
Private Market	$347,746	$7,581	$801
Private Nonmarket	$424,769	$9,260	$979
Social	$309,280	$6,742	$713
Overall Benefits	$1,081,795	$23,583	$2,493
Panel B. Estimates from Agan, 2014 and from Carroll and Erkut, 2009			
Private Market	$144,884	$3,158	$334
Social	$62,759	$2,067	$219
Overall Benefits	$207,643	$5,226	$552

Note: All dollars represent net present value $2017 dollars. The "benefits of 2 years of higher education" are the total benefits of a single student obtaining 2 years of higher education compared with a high school graduate. The "benefits per student attributed to dual-credit enrollment" are the total benefits shown in the first column multiplied by the impact of dual-credit on obtaining a two-year credential (0.0218). The "benefits per SCH" is the benefits attributed to dual-credit divided by 9.5 (the average number of SCHs taken by dual-credit students).

The benefits to society and savings on governmental spending resulting from more education are also substantial.

In addition to benefits to the individuals who engage in higher education, there are also societal benefits—what McMahon calls social benefits—accruing to the population regardless of whether they participated in higher education or not. In this group of benefits, McMahon includes democratization (or functioning governmental institutions), support of human rights, political stability, increased life expectancy, reduced economic inequality, reduced crime, decreased costs of social supports (welfare, health care, prison costs), and improved environment. McMahon estimates that the sum of these social benefits is almost has high as private market benefits. Lifetime social benefits for each individual participating in two additional years of higher education amount to more than $309,000.

McMahon's concept of social benefits is certainly very inclusive of a wide range of benefits. In contrast, Carroll and Erkut (2009) and Trostel (2010) calculate benefits to the government from individuals participating higher education. Carroll and Erkut (2009) simply accounts for the increased tax revenue brought in by individuals with higher education levels and the decrease in governmental spending on social programs and prisons. Their estimated benefits for individuals with some college are much more conservative at $62,759. Trostel (2010) also accounts for various types of taxes and decreased governmental spending on social supports and calculates a benefit of $229,525 for individuals earning a bachelor's degree. If we assume that the benefit from an associate's degree is half as much as a bachelor's degree, this would amount to benefits of $114,762. These figures are shown in Panel B of Table 4.10 as social benefits.

Total benefits attributable to dual-credit education from earning a two-year credential are large.

Summing up the private market, private nonmarket, and social benefits from McMahon (2009), the total lifetime benefit for a student completing a two-year credential amounts to a little more than $1 million. Summing up the most conservative estimates of private and social benefits from 2 years of college yields an estimate for total benefits of almost $208,000, as shown in the bottom row of Panel B of Table 4.10.

The impact estimate indicates that students who took dual-credit are 2.2% more likely to earn a credential from a two-year college, indicating completion of 2 years of college. Applying the impact estimate to the benefits of 2 years of higher education, the benefit per dual-credit student is almost $24,000: $7,600 in private market benefits, $9,300 in private nonmarket benefits, and $6,700 in public benefits. When converted to a per SCH basis, the overall lifetime benefits amount to almost $2,500 per dual-credit SCH taken. Even when we use the more conservative estimates of benefits

from Agan (2014) and Carroll and Erkut (2009), shown in Panel B of Table 4.10, the benefits come to $552 per SCH resulting from being more likely to complete 2 years of higher education.

Comparison of Costs and Benefits

The benefits attributable to dual credit far exceed the costs of dual credit.

With average statewide costs of $111 per SCH, the benefits that result from reduced time to degree for four-year graduates alone is larger than the costs. Specifically, the benefits of reduced time to degree of $131 per SCH exceed the costs by $20 per SCH, resulting in a benefit-to-cost ratio of 1.18, meaning that the benefits from reduced time to degree alone are 18% higher than the cost. In other words, each dollar invested in dual credit returns $1.18 from students spending less time in college and entering the workforce earlier.

The estimated benefit-cost ratio of 1.18 only includes the benefits associated with dual-credit students finishing college earlier, compared with college completers without dual credit. Dual credit also increases the likelihood a student completes a two-year credential, which provides monetary benefits over the student's lifetime. Using a conservative estimate of $552 per SCH for lifetime benefits from earning a two-year credential, the benefits exceed the cost by $441. This results in a benefit-to-cost ratio of 4.98, meaning that the lifetime benefits of dual credit exceed the cost by almost 400%. Using the more inclusive set of benefits specified by McMahon (2008), the benefits exceed the costs by almost $2,400 and the benefit-to-cost ratio is almost 22.

The social benefits under the most conservative approach represent benefits to the government from increased tax revenue and decreased social spending. The social benefits from earning two-year credentials exceed the cost of dual credit by $107, for a benefit to cost ratio of almost 2.0. This indicates it is well worth the public investment in dual-credit opportunities. With that said, the private return is even higher, indicating that students and families should also be willing to contribute to the cost of dual credit.

Chapter Conclusion

In this chapter, we examined the cost of dual credit, reported average costs per SCH and total costs of dual credit in the state, examined which stakeholders bear the cost of dual credit under several tuition and fee scenarios, and compared the costs of dual credit to calculated benefits of dual credit. Following, we summarize our key findings:

- **Overall cost of providing dual-credit instruction is $111 per SCH, or $121.7 million statewide in 2016–17.** On average, the cost of dual-credit education to colleges far outweighs the additional state funding they receive from providing dual-credit instruction. When community colleges

waive tuition, the average cost of dual credit for community colleges is $86 per SCH (77% of the total cost). Community colleges receive, on average, $38 per SCH in state funding.

- **Tuition and fees arrangements vary widely across the state and have significant effects on the distribution of costs.** When tuition is waived, colleges bear 77% of the cost, compared with 11% for districts and 12% for students, on average. Conversely, when districts pay tuition for dual-credit students, colleges pay, on average, 41% of costs, school districts pay 47%, and students pay 12%. In some regions, tuition is waived for most classes, and districts pay the costs of textbooks and placement test fees so that the upfront cost to the student is effectively zero.

  The strongest predictor of overall costs and how costs are distributed across stakeholders is the type of instructor teaching the course. Assigning part-time college faculty to teach dual-credit courses is the least expensive delivery mechanism; however, this approach may not be the most cost-effective because high school teachers or full-time college faculty may be more effective instructors. Full-time college faculty members are 2.5 times more expensive, on average, than part-time college faculty on a per SCH basis. When courses are taught by college faculty, colleges bear more of the cost of dual-credit, and school districts receive cost savings resulting from a reduction in the instructional burden on high school teachers. The cost of dual-credit education is shifted from colleges to school districts when courses are taught by high school teachers. Because of the difference in cost burden according to who teaches the course, colleges should consider charging differential tuition rates for various teaching arrangements (a model used in some of the sites we sampled).

- **The costs of dual-credit delivered through ECHSs is greater overall, but similar on a per-SCH basis.** Although ECHSs generally have greater staffing levels per student, each student in an ECHS receives a greater number of SCHs, compared with students enrolling in dual credit in traditional comprehensive high schools. As a result, the cost per SCH of administration and advising is only slightly higher in ECHSs. ECHSs typically shift a substantial proportion of costs from school districts to colleges because ECHSs are more likely to have dual-credit courses taught by college faculty, rather than high school teachers.

  The short-term benefits related to reduced time to degree are 1.18 times the cost of dual credit. Long-term monetary benefits associated with a greater number of college graduates are almost five times the cost of dual credit. Benefits from reduced time to degree were $131 per SCH—18% larger than the cost of dual credit. The most conservative estimate of lifetime benefits from increased earning of two-year credentials was $552 per SCH—almost 400% larger than the cost of dual credit. The considerable value of benefits compared with costs suggests that investments in dual credit will result in large future payoffs to both individuals participating in dual credit and the public at large.

Chapter 5. Conclusion

Findings from this study make clear that dual-credit education is a worthwhile investment for Texas high school students and the state of Texas. Findings also highlight areas in which policies and practices can be improved to help ensure that dual-credit education benefits all participating students in the future. This conclusion chapter highlights the most salient takeaways from each study component and provides additional findings that we believe are of importance to dual-credit education stakeholders. Then, we distill the comments we received from dual-credit stakeholders during the public comment period following the release of the draft final report in July 2018. We conclude this report with recommendations on how to improve dual-credit policy and practice based on the findings of this study.

Racial Disparities Study Component

Key Finding

Differences in academic preparation, income, and high school attendance patterns serve as major contributors to racial and ethnic disparities in dual-credit participation. Our descriptive analyses showed that the dual-credit participation rate of White students was 24.8%, while the corresponding rate for Black students was 10.9%—a gap of 13.9 percentage points. However, when we used regression methods to account for differences in academic preparation, income, and the high schools students attended, those gaps narrowed by almost six-fold. Using the same analytic techniques, we found little evidence that access to dual-credit coursework, access to AP/IB courses, and access to tuition and fee waivers made any difference in terms of narrowing these racial and ethnic disparities.

HB 505 Study Component

Key Findings

Dual-credit participation and SCH taking have increased since HB 505, primarily for ninth and 10th graders. Our analysis showed that dual-credit participation among all high school students was 7.5% prior to the passage of HB 505 (during the period 2012–15) and increased to 8.5% from 2016 to 2017. This change represents a 13% increase in the dual-credit participation rate over a six-year period. The rate of growth of dual-credit participation was particularly strong for ninth and 10th graders. Ninth graders increased their dual-credit participation rate from 1.0% before HB 505 to 2.1% after, an increase of 110%. Tenth graders increased their dual-credit participation rate by 60%, from 2.7% before HB 505 to 4.3% after. There was also a significant increase in the number of SCH taken per dual-credit participant, leading to a continued increase

in the number of SCH of dual-credit delivered statewide from 2012 to 2017. The total number of dual-credit SCH taken in 2012 was 717,756; in 2017, that number increased to 1,115,113.

Since passage of HB 505, the academic preparation of ninth and 10th-grade dual-credit participants has declined, while the share of those students receiving A grades in their dual-credit courses has increased. We found that ninth- and 10th-grade students who participated in dual-credit education after HB 505 scored lower on eighth-grade standardized tests compared with ninth and 10th graders who participated in dual-credit education before HB 505. At the same time, we also found that ninth- and 10th-grade students who participated in dual-credit education after HB 505 also experienced higher course pass rates. These patterns were not evident among 11th- and 12th-grade dual-credit participants.

Causal Impact Study Component

Key Findings

Dual-credit education boosts college enrollment and completion primarily among two-year institutions. Findings from the causal impact study generally demonstrate that students benefit from participating in dual-credit education. After controlling for differences between dual-credit students and nondual-credit students, such as their academic backgrounds, drive to succeed, and the types of high schools they attended, we found that dual-credit education directly increased college enrollment by 2.4 percentage points, and college completion by 1.1 percentage points. These improvements were primarily a result of a higher percentage of students enrolling in two-year college and completing a workforce certificate or an associate degree. Dual-credit education programs also reduce the amount of time students invest in pursuing a postsecondary degree by about one summer term. The results reflect the effectiveness of dual-credit education relative to improving college access and success before the Texas Legislature passed HB 505 in 2015.[27]

[27] It is important to note that although these estimates are lower than those reported by existing descriptive studies (Giani, Alexander, & Reyes, 2014; Kim & Bragg, 2008; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018), they more accurately measure the academic benefits of dual-credit education programs. The greater accuracy is a result of the methodology used to produce estimates, which controls for a wider range of student and high school characteristics that influence not only the extent to which a student enrolls in dual-credit education, but also how well a student performs in high school and college. Without adequately controlling for the differences between students who take dual-credit courses and those who do not, it is impossible to isolate the direct effect of dual-credit education programs from other factors, such as academic ability and drive, on student short- and long-term outcomes. These causal estimates are in line with results from other impact studies examining the effect of AP courses on similar measures of student success using Texas data (Jackson, 2010; 2014; Klopenstein & Thomas, 2009).

Low-income students and students of color benefitted less from dual-credit education delivered in traditional high schools compared with affluent and White students. Our results show lower levels of academic preparation—measured by eighth-grade standardized test scores in reading and mathematics—was a primary factor explaining why students of color and low-income students benefitted less from dual-credit education. Other research suggests that having fewer mentors or college-educated family members (Castleman, Page, & Schooley, 2014) and experiencing higher rates of chronic or episodic acute stress (Hopson & Lee, 2011), may also help to explain why the benefits of dual credit are unequal across student groups. Taken together, these findings suggest that academic preparation and adequate supports may be critical for helping disadvantaged students benefit from dual-credit education.

Advising Study Component

Key Finding

Constraints faced by high school counselors and college advisors compromise the quality of advising that dual-credit students receive. This study shows that many college advisors and high school counselors are challenged to ensure that dual-credit students enroll in courses that follow a coherent, efficient educational pathway to a degree. Data collected from the advising study demonstrated that advisors and counselors often lack the supports and information needed to help ensure that dual-credit students can transfer credits toward the requirements for their majors.

Compounding this problem is that data also show that high school counselors were on the front lines of advising dual-credit education students. The concern is not that high school guidance counselors play a primary role, but that they often lack the resources, time, and knowledge needed to provide effective advising with a college perspective. To be sure, high school counselors are invaluable in ensuring that dual-credit students stay on track to satisfy their high school graduation requirements; however, college advisors typically have more experience, insights, and access to information about credit-transfer policies that could help steer students away from courses that could lead to excess or misdirected credit.

Based on this evidence, counselors would benefit from a greater knowledge and understanding of dual-credit implications for their students after high school. In interviews, counselors reported they had few opportunities to participate in dual-credit training provided by colleges, and that their abilities to effectively advise students would be enhanced by more specific guidance on advising dual-credit students from the perspective of their postsecondary degree pursuits and the benefits and pitfalls of taking certain courses relative to their long-term

postsecondary trajectories. Advisors and high school counselors also emphasized that dual-credit advising for students would be improved if college counselors had more opportunities to meet individually with students and thus to apply their knowledge and college-level point of view to students' course-taking decisions.

Other Important Findings

- **Student-borne costs, extracurricular activities and scheduling challenges were the most common barriers to dual-credit participation for academically qualified students according to guidance counselors and advisors.** Approximately one quarter of high school guidance counselors reported that some of their qualified students were not able to participate in dual-credit education. The costs associated with taking dual-credit classes was mentioned most frequently, particularly by advisors and counselors serving rural communities where many of the students were economically disadvantaged. Another commonly perceived barrier among these respondents was the number of other activities in which students were involved, such as jobs, sports, performances, and honor societies and that competed for their time. High school counselors also described the difficulty some students had in fitting dual-credit courses into their daily schedules.
- **The extent to which high school counselors and college advisors actively targeted students for dual-credit education varied based on several factors, including state and district policies and school philosophies regarding which students could benefit from and succeed in dual-credit courses.** All interviewees indicated that they targeted students for dual-credit programs based on a combination of state rules, district policies, and MOUs in place with their partners. Within these parameters, counselors and advisors varied in the extent to which they actively recruited academically excelling or disadvantaged students.
- **High school counselors and college advisors most commonly suggested that greater clarity on credit-transfer policies, having dedicated and well-trained dual-credit staff, and early counseling could improve dual-credit student advising.** Nearly half of interviewed high school counselors and about one quarter of interviewed college advisors expressed a desire for more guidance and clarity on credit transfer policies and, specifically, on what courses transferred to a given college or university to better guide dual-credit students' course selections. Although interviewees reported turning primarily to college websites and the Texas Common Course Numbering System for this information, they nevertheless wanted a more streamlined and uniform process for locating credit-transfer information.

  A minority of high school counselors and of college advisors indicated that having well-trained, dedicated dual-credit advisors would improve student advising. In addition, few

high school counselors reported receiving any specific dual-credit advising training, and many counselors and college advisors suggested that training for dual-credit advisors at both the college and high school levels would be beneficial. Furthermore, high school counselors and college advisors suggested a need to begin advising students earlier about dual-credit education and dual-credit pathways into college because they thought earlier counseling would better prepare students and families to make strategic decisions about dual-credit education.

Academic Rigor Study Component

Key Finding

Evidence suggests that dual-credit courses are equally as rigorous as college credit-only courses. Although based on a limited set of College Algebra and English Composition courses delivered for dual credit and college credit only, our findings reflected more commonalities than differences in the ways that instructors taught these two types of college-level courses. Specifically, we found that college faculty (DC) and high school teachers (HSDC) teaching dual-credit courses and college faculty teaching college credit-only courses (CC) delivered similar content, developed similar student assignments, and assessed student responses to those assignments using similar metrics and standards. College Algebra and English Composition are two of the most common college-level courses taught for dual credit.

Cost Study Component

Key Finding

The benefits generated by dual-credit education greatly exceed the cost of delivery. Our estimates suggest that, on average, the monetary benefits generated by dual-credit education are five times the costs of program delivery over and above that of providing a course that counts for high school credit alone. The most significant benefit of dual-credit education is seen in dual-credit students' increased postsecondary educational attainment, which leads to increases in lifetime earnings for individuals and social benefits for the state, such as reduced governmental spending on social programs and increased tax revenues. The other major benefit of dual-credit education is seen in the reduced time to degree for individuals completing a four-year degree. This benefit leads to a reduction in college spending and earlier entry into the workforce.

Other Important Findings

- **Our estimate of the overall cost of providing dual-credit instruction was $111 per SCH, or $121.7 million statewide in 2016–17.** On average, the cost to colleges of delivering dual-

credit education far outweighed the additional state revenues they received by providing dual-credit instruction. When community colleges waived tuition, the average cost of dual credit for community colleges was $82 per SCH (74% of the total cost). Community colleges received, on average, $38 per SCH in state funding.

- **Tuition and fees arrangements varied widely across the state and had significant effects on the distribution of costs.** When tuition was waived, colleges bore 74% of the cost of dual-credit instruction, compared with 14% for districts and 12% for students, on average. Conversely, when districts paid tuition for dual-credit students, colleges paid, on average, 38% of costs, school districts paid 51%, and students paid 12%. In some regions, tuition was waived for most classes and districts paid the costs of textbooks and placement test fees so that the upfront cost to students was effectively zero.

  The strongest predictor of overall costs and of how costs were distributed across stakeholders was the type of instructor teaching the course. When courses were taught by college faculty, colleges bore more of the cost of dual-credit education. Full-time college faculty members were 2.5 times costlier, on average, than part-time college faculty on a per-SCH basis. When courses were taught by college faculty, school districts received cost savings resulting from reductions in the instructional burden on high school teachers. The cost of dual-credit education shifted from colleges to school districts when courses were taught by high school teachers. Assigning part-time college faculty to teach dual-credit courses was the least expensive delivery mechanism; however, this approach may not have been the most cost-effective strategy because high school teachers or full-time college faculty may have been more effective instructors. Given the difference in cost burden according to who teaches the course, colleges should consider charging differential tuition rates for various teaching arrangements (a model used in some of the sites we sampled).

- **Our estimate of the cost of dual credit delivered through ECHSs was greater overall but was similar on a per-SCH basis.** Although ECHSs generally had larger staffing levels per student, each ECHS student received a greater number of SCHs compared with students enrolled in dual-credit programs delivered by traditional, comprehensive high schools. As a result, the cost per SCH of administration and advising was only slightly higher in ECHSs. ECHSs typically shifted a substantial proportion of costs from school districts to colleges because ECHSs were more likely to have dual-credit courses taught by college faculty rather than by high school teachers.

Study Recommendations

Determining how policy and practice should change based on our research requires input from stakeholders representing various perspectives. To collect this input, we engaged in several efforts. First, we released a draft report for public comment at the July 26, 2018, THECB Board Meeting and accepted feedback through August 27, 2018. Second, we presented findings from the study to community college stakeholders at the August 2, 2018, annual conference of the Texas Association of Community Colleges. Finally, we conducted a webinar on August 3, 2018, that was designed to disseminate study findings to a broader array of stakeholders. We used this feedback to help better contextualize our findings and to craft a set of practical recommendations based on our research. Below, we summarize the main themes of the public comments we received and how we modified the report in response to them. We then present our study recommendations.

Public Comments

We received 42 comments from interested stakeholders during the public comment period. Appendix H shows all of the comments and the number of individuals or organizations that made each comment. Below, we share the most frequent comments and describe how we modified the report in response to each.

Twenty-four comments expressed concerns related to the methodology we used for the causal impact study. As with any study, there are limitations to an adopted study design. While we made a concerted effort to minimize these limitations when designing our methodological approach, we recognized that our methodology would raise questions and concerns and, in response, took steps to ensure the quality and appropriateness of our approach and made appropriate refinements to ensure we provided stakeholders with a truer account of the benefits of dual-credit education. For example, AIR's quality assurance team evaluated the methodology, and we also have presented the methodology to economists from RAND, the University of Texas at Austin, and Brigham Young University. These researchers are experts in conducting impact studies within the field of education and, based on their feedback, we refined our methodology to reduce bias in our estimates.

Given the high-profile nature of this report, we sought feedback from an additional external reviewer, a respected researcher in the field of economics of education. The reviewer agreed that we made appropriate choices in designing the causal impact study and that our estimates addressed methodological limitations of existing descriptive studies. In addition, the reviewer offered further insights into the limitations of our approach and recommended that these

observations be noted when presenting the study's findings. Specifically, the reviewer noted several factors that could cause our estimates to misstate the true effect of dual-credit education; however, most of the factors that the reviewer identified would lead us to overestimate the benefits of dual-credit education rather than underestimate them The reviewer also asserted that our methodology represented an improvement relative to descriptive analytic techniques because it more effectively controlled for a greater number of factors that might bias our analysis of the impact of dual-credit education.

In this report, we respond to public comment that raised concerns about the study's methodology by describing the methodology in more detail, the rationale for selecting it for answering this study's specific research questions, and both its strengths and limitations in estimating the true effects of dual-credit education on student outcomes.

Thirteen comments suggested we should include ECHSs in the causal impact study. At the time we designed the causal impact study, two experimental studies already had demonstrated that ECHSs are an effective means of increasing college participation and completion, particularly for disadvantaged students. In an effort to avoid the duplication of research, we decided to examine the impact of dual-credit education delivered in traditional high school settings, where much less is known .

In response to public comment, we expanded our description of existing impact research on ECHSs and drew upon it to contextualize our findings and make policy recommendations. For example, we believe that the overall body of evidence suggests that ECHSs should play a critical role in helping Texas continue to close the dual-credit participation gap by race and ethnicity while also ensuring that students are adequately prepared and have necessary supports to succeed in dual-credit courses.

Four comments suggested the report should include more regional data. We agree that regional data is crucial for gaining a thorough understanding of any policy in a large and diverse state such as Texas. RAND reported regional data in the Phase I report (Miller et al., 2017), and the report now explicitly points to this evidence from that document.

Four comments suggested that our study pointed to the need for improved advising and degree-planning for dual-credit students. We agree, and this is one of our study's recommendations.

Three comments applauded our work on rigor and suggested more studies should be conducted. We appreciate the praise, and we agree that it is important for institutions to

continue to ensure that their dual-credit courses are as rigorous as college credit-only courses. One of this study's recommendations reflects this view.

Study Recommendations

If Texas intends to meet the goals of *60x30TX,* it must ensure that dual-credit education programs benefit all students, particularly those who face formidable challenges accessing, completing, and affording college. The recommendations, which are based on the results of this study, offer stakeholders guidelines on how to strengthen and improve dual-credit education as it continues to expand and evolve to meet the needs of an increasingly diverse student population.

Ensure that students are adequately prepared to succeed in and have the necessary supports to benefit from dual-credit education programs delivered in traditional high schools. Our study suggests that academic preparation is important for ensuring student success in dual-credit programs delivered in traditional high school settings. Results from the causal impact study demonstrated that, on average, disadvantaged students benefitted less from participating in dual-credit education than their more advantaged peers, in part because they had lower scores on eighth-grade reading and mathematics standardized tests. Notably, for disadvantaged students who achieved test scores one standard deviation above the average score, participation in dual-credit programs delivered in traditional high school settings improved a range of college outcomes. This finding is promising and shines yet another spotlight on the urgency of closing persistent subgroup gaps that too often emerge and grow during students' elementary and secondary pathways.

Our evidence points to lower academic preparation as one explanation for disparities in college access and completion among dual-credit students. Other research suggests more reasons for those disparities as well, and our study was not able to fully investigate them. For example, many studies note that low-income students and students of color have fewer college-educated family members and mentors who can help them navigate the complexities of college (Castleman, Page, & Schooley, 2014; Rall, 2016). Furthermore, other studies show that these types of students encounter formidable challenges and life stressors, such as caring for younger siblings and working multiple jobs to support their families, that make accessing and succeeding in college an even more difficult endeavor (Hopson & Lee, 2011). Dual-credit programs should be designed and structured to meet the academic, informational, and financial needs of students in these circumstances to increase the benefit of participating in college-level coursework for a greater number of students. Experimental research on ECHS suggests that dual-credit education programs that embed strong student services, such as regular tutoring

and intrusive advising, show promise in supporting students who have been traditionally underserved by the K–12 education system (Edmunds et al., 2010; Edmunds et al., 2012; Edmunds et al., 2017). Our advising study also suggests that ECHS students have greater access to these types of supports as they navigate dual-credit courses and pathways into college. Identifying which student supports efficiently and effectively increase the success of traditionally underserved students enrolled in dual-credit education is an area that merits attention and further research, particularly in light of the continuing expansion of dual-credit education programs in Texas.

Strive to guarantee that costs neither serve as a barrier for students to participate in dual-credit education nor inhibit higher education institutions from offering affordable, high-quality dual-credit education programs. High school guidance counselors reported that the costs of tuition, fees, and books were barriers to dual-credit participation for some students, and our findings indicate that income plays a role in the gap in dual-credit participation across race and ethnicity. This suggests that the costs of delivering dual-credit education program, when shifted to students, may weigh heaviest on low-income students and their families. Furthermore, we estimated the average cost of delivering dual-credit education to be $111 per SCH, an amount over and above the cost of delivering the same credit hour for high school credit only. In the absence of charging tuition and fees, community colleges pay for 77% ($86) of the overall cost per SCH. Meanwhile, the state revenue needed to offset those costs was derived primarily from formula funding and averaged $38 per SCH. To make up that gap, many community colleges charged dual-credit students tuition and fees, and many school districts required them to pay for textbooks and other course materials. While charging students tuition and fees to cover a proportion of delivery costs is reasonable, doing so may come at the expense of broadening access to dual-credit education. Our analysis found that providing dual-credit students some form of financial relief increases the share of costs covered by the college or the school district, particularly when they are unable to rely on other revenue streams to make up that difference. Indeed, even the best resourced institutions and districts may reach a point where offering tuition and fee waivers to dual-credit students becomes unsustainable. Left unchecked, these issues could increase the cost of dual-credit education for students and exacerbate inequities in dual-credit participation by race and ethnicity and income. However, when considering ways to boost funding for dual-credit programs to address these issues, policymakers should consider trade-offs with respect to other uses of scarce state resources.

Continue to close gaps in dual-credit participation rates across race and ethnicity. Texas has made considerable progress in increasing the rate at which students of color participate in dual-credit education. However, a significant gap in participation rates by race and ethnicity persists.

As previously discussed, our analyses suggest these disparities are driven by differences not only in levels of academic preparation, but also by income and by the types of high schools that students attend.

To narrow these disparities, stakeholders should invest in initiatives—starting as early as elementary and middle school—that level the playing field of postsecondary opportunity for all students, regardless of their resource levels or degrees of college exposure. Stakeholders also must ensure that efforts to close gaps in dual-credit participation do not encourage or incentivize academically underprepared high school students to enroll, unless the incentives are coupled with robust academic services and supports to ensure that students are able to reach their academic potential and goals without falling farther behind as a result of their participation. Continuing to scale effective, well-implemented ECHS programs that are targeted at disadvantaged students could play a vital role in helping the state to close the participation gap while also ensuring that disadvantaged students benefit from dual-credit programs.

Encourage institutions to continue developing and implementing processes to ensure that dual-credit courses remain as rigorous as college credit-only courses. Our study found encouraging evidence regarding the rigor of dual-credit courses relative to those taught for college credit only. We collected detailed course materials, including graded student assignments, from instructors of College Algebra and English Composition courses, and we found few differences between dual-credit and college credit-only versions of those courses. Our study was limited in that we had the resources to look only at two courses delivered by a limited number of instructors. More work would be needed to show that all dual-credit courses are as rigorous as college credit-only courses. However, findings from our study provide evidence that may negate concerns that dual-credit courses as implemented in Texas are less rigorous than college credit-only courses being delivered at community colleges.

Nevertheless, it is important to emphasize that two- and four-year colleges should continue monitoring and assessing the academic rigor of dual-credit courses to ensure that students benefit from dual-credit education after they graduate from high school. One approach to ensuring equivalence in academic rigor might include developing common assessments (i.e., assignments and tests) that would be administered to dual-credit and college credit-only students and that would assess differences in performance on those assessments between both student groups. Another approach could involve using college credit-only and dual-credit instructors to jointly grade dual-credit student assignments and tests based on academic benchmarks set for college credit-only courses. Finally, we encourage practitioners to draw

from the rubric we developed for this study to assess similarities and differences between dual-credit and college credit-only courses for content, student assignments, and grading standards.

Improve the advising processes and ensure equitable access to high-quality advising for dual-credit students. Our research on dual-credit advising found that the bulk of advising services offered to dual-credit education students is far more typically provided by high school guidance counselors than by college advisors. The concern is not that high school guidance counselors are on the front lines, but that they often lack the resources, time, and the knowledge needed to advise dual-credit students in ways that bring a college perspective. To be sure, high school counselors are invaluable in ensuring dual-credit students stay on track to satisfy their high school graduation requirements and are typically better positioned than college advisors to assess students' emotional readiness for the expectations and culture of college classrooms.

Nonetheless, our study suggests that the quality of advising could be enhanced if dual-credit partnerships engaged in several efforts. First, partners should more directly engage with college advisors in counseling and guiding the course-taking choices of dual-credit students. College advisors typically have more experience, insight, and access to information about credit-transfer policies and are able to refer students to courses that map directly to the requirements of a particular major. Respondents in our advising study also highlighted the benefits of students consulting directly with college advisors, noting that guidance provided by college advisors tends to bear more weight in their course-taking decisions.

Second, partners should begin advising potential dual-credit students early. Early advising could involve creating opportunities for students to explore postsecondary options including potential degree and career pathways. This approach could be particularly effective for students who can access dual-credit education as early as their ninth- or 10th-grade years. Finally, both college advisors and high school counselors indicated that formal training specific to dual-credit education was lacking and that more targeted training for high school counselors (potentially including joint training opportunities for counselors and college advisors within partnerships) could help ensure that dual-credit students and their families are counseled to make wise choices about pursing dual-credit opportunities.

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Appendix A. Data and Methods

In this Appendix, we describe the data used in our quantitative analyses and provide additional details about specific methods used for particular analyses beyond what is reported in the main report. We also provide more detailed results than what is provided in the body of the report.

We begin this appendix by describing the data and then describe the different methods we use to conduct our analysis. We also go on to show results from analyses employing those methods.

Data

In this section, we describe the administrative data files that we used to conduct our quantitative analyses, and how we linked them at the individual level and over time to construct our analytic data files.

Administrative Data Files

We draw on administrative records collected by THECB and TEA for all quantitative analyses. Below, we describe employed THECB administrative data files:

CBM001: Public Universities and Community, Technical and State Colleges Enrollment Report (2001–17). This file captures college enrollment at all public HEIs in Texas, including public two- and four-year colleges. The file captures the number of SCH attempted each semester at all colleges in the state. Beginning in the 1999-2000 academic year, the file began distinguishing between DC and traditional college SCH. We use the data starting in academic year 2000-2001. The file also captures demographic information about all public college students in the state. We use this file to capture information about DC participation, college enrollment, and SCHs earned.

CBM001: Independent Colleges and Universities Enrollment Report (2003-2017). This file captures college enrollment at all private HEIs in Texas, including private non-profit two- and four-year colleges. First collected in the 2002-2003 academic year, the file captures the number of SCH attempted each semester at all colleges in the state. The file also captures demographic information about all private college students in the state. We use this file to capture information about DC participation, college enrollment, and SCHs earned from private colleges in Texas.

CBM009: Public Universities and Community, Technical and State Colleges Graduation Report (2001–17). This file captures information about all degrees and certificates conferred to students who were enrolled at any public HEIs in Texas, including two- and four-year colleges. We used this file to capture information about college completion.

CBM009: Independent Colleges and Universities Graduation Report (2003-2017). This file captures information about all degrees conferred to students who were enrolled at any private HEIs in Texas, including two- and four-year colleges. We used this file to capture information about college degree completion.

CBM00S: The Student Schedule Report (2012-2017). This file captures detailed transcript-level information for all students enrolled at any public two- or four-year HEI in Texas. We use this file to capture detailed information about course performance in DC and courses taught for college credit only. We also use this file to capture detailed information about course mode and location. This file is also used to examine changes in DC courses after HB 505. Since THECB only began collecting this information in 2012, we can only examine these data for 2012-2017 fiscal years.

CBM008: The Faculty Report (2012-2017). This file captures detailed information about faculty members teaching courses at public two- or four-year HEI in Texas. We use this file to capture information about the rank, highest degree earned, and employment status (full time, part-time or adjunct) for the faculty member of record for each course delivered at Texas public two- and four-year colleges from 2012–2017.

We also draw upon several administrative files from TEA. These include:

TEA Enrollment File (2001–17). This file captures enrollment information on all students of Texas public high schools. This includes demographic information and information about the high school that the student attended. We use this file to identify cohorts of junior year students to track into Texas public colleges and to identify the grade during which students took DC courses, if any.

TEA High School Graduation File (2001–17). This file captures information about all graduates of Texas public high schools. This includes the year in which the student graduated from high school, and the high school that conferred the degree, and basic demographic information. We use this file to examine high school graduation.

TEA Employment Records (2012-2017). This file captures information about all employees of Texas public schools. We use this file to identify college courses delivered in 2012–2017 whose faculty member of record was employed as a teacher in a Texas public school in those years.

TEA Eighth-Grade Test Score (1998-2016). This file captures eighth-grade test score information for all students of Texas public high schools. This includes the Texas Assessment of Academic Skill (1998-2002), the Texas Assessment of Knowledge and Skills (2003–2011), and

the State of Texas Assessments of Academic Readiness (2012–2016). We center all student test scores around the average of each year so that the test scores can be compared across years. We use this to control for a student's academic performance before high school.

National Student Clearinghouse

We also draw upon data collected by the National Student Clearinghouse (NSC). The NSC is a nonprofit organization that provides enrollment and degree verification services for postsecondary institutions. The overwhelming majority of postsecondary institutions nationally outsource these services to the NSC. According to NSC, they capture 99% of all college enrollment nationally. THECB contracts with NSC to obtain information on Texas public high school graduates who enroll in postsecondary institutions outside of Texas. THECB has access to NSC enrollment and degree records from 2009–17. We use this file to capture information about college enrollment and degree completion outside the state of Texas

Early College High School Data

Finally, we also draw upon a file that captures information on the date when a public high school was designated an ECHS by TEA. The file contains the codes for each ECHS, as well as an indicator for whether or not the ECHS was a standalone high school or embedded within a larger high school with the same TEA high school code. We use this file to develop indicators of enrollment in ECHSs.

Construction of Datasets

We link the files above across time and at the individual student level using SSNs to create two analytic files that we use in our quantitative analyses. Table AE.1 describes the key variables included in each file and the cohorts for which each variable is available.

First Analytic File

The first file, referred to as the "Student File," tracks cohorts of 11th-grade students for 2001–16 students of Texas public high schools, capturing DC SCH starting in a student's junior year of high school and college enrollment and degree completion up to ten years starting with a student's junior year of high school. Since we only have enrollment data from 2001–17, we are only able to create certain indicators for specific cohorts, as described below. The file captures detailed student information from the TEA enrollment file, including race/ethnicity, free lunch status, eighth-grade test scores, an indicator for whether or not the student participated in a Gifted and Talented program, an indicator for whether or not the student is considered at-risk

of dropping out of high school, and an indicator for whether the student was identified as an English Language Learner.

This file also captures information about whether the student graduated from a HS that was either a standalone ECHS or had an ECHS embedded within it. The file captures outcomes including college enrollment (defined as enrolling full or part-time during the Fall or Spring semester two years after their 11th grade in high school), and completion (defined as having completed any postsecondary credential within ten years of their 11th grade in high school). The file also has indicators for enrolling in a two-vs. four-year college, and completing different postsecondary credentials. Finally, the file includes data on SCH-to-degree, SCH taken in college to degree, and time-to-degree for students enrolling in a HEI during the Spring or Fall Semester immediately following high school graduation and completing a four-year degree within ten years of 11th grade.

Second Analytic File

The second file, referred to as the "Course File," which contains all of the scheduling information for dual-credit courses between 2012-2017 at all public and private HEIs in Texas. This file gives information on the grade that students received in a DC course, where and how the class was taught, and the characteristics of the teacher who taught that course. The data was matched to TEA data to capture student level information for students taking the DC courses including race/ethnicity, free/reduced priced lunch eligibility, eighth-grade test scores, an indicator for whether or not the student participated in a Gifted and Talented program, an indicator for whether or not the student is considered at-risk of dropping out of high school, and an indicator for whether the student was identified as an English Language Learner. We use the Course File to analyze how DC courses and the composition of DC courses have changed after the passage of HB 505.

Table A.1. Key Variables by Student and Course File

DC Participation	Student Info	Context	Outcomes	Efficiency
Student File: Variables Generally Available 2000-2016 Unless Otherwise Noted				
DC Participation 11th-12th Gr	Race/Ethnicity	High School information	Enroll two-- or four-year	SCH-to-Degree
DC SCH 11th-12th Gr	Free/Reduced Price Lunch eligibility		Graduation two- or four-year	Net SCH-to-Degree
	8th Grade Test Scores		Credential two-or four-year	Time-to-Degree
			High School Graduation	
Additional Variables Available in Course File:Variables Generally Available 2012–17 Unless Otherwise Noted				
Specific DC Courses	Race/Ethnicity	Location	Grades and Pass Rates in DC courses	
	Free/Reduced-Price Lunch eligibility	Mode		
	Eighth-Grade Test Scores	Faculty Characteristics		
		Academic vs. CTE		

Beginning in 2012, THECB began collecting detailed transcript-level information (CBM00S) about all college courses taken at any public HEI in the state. The file includes detailed course and section identifiers that allow us to link courses to information about their faculty member of record from the CBM008. For students taking courses in 2012-2017, we link the student level file above to additional course-level information about all college level courses taken by students of Texas public high schools. The file includes information about enrollment and course performance for particular DC courses, information on location (high school vs. college campus, mode of instruction (face-to-face, online, or hybrid), faculty characteristics (whether or not the instructor was employed as a public school teacher in Texas, highest degree earned, full- or part-time status, and adjunct status.

The table below describes each outcome examined in our analysis. It details how each outcome is defined, the high school graduate cohorts that is examined for each outcomes, the number of the students in those cohorts, and the conditioning that is necessary to analyze each outcome.

Table A.2. Definition of Outcomes

Outcome	Definition	Cohorts Examined	Number of Students	Conditioning
Graduated HS	Student graduated from HS on time	2001–16	3,411,286	
Enroll two-year	Student enrolled in a two-year college two years after junior year.	2001–15	3,223,430	
Enroll four-year	Student enrolled in a four-year college two years after junior year.	2001–15	3,223,430	
Enroll two- or four-year	Student enrolled in a two- or four-year college two years after junior year	2001–15	3,223,430	
Graduated two-year	Student completed an Associate's degree from a two-year college within 5 years of junior year	2001–13	2,754,765	
Certificate two-year	Student received a certificate from a two-year college within 5 years of junior year	2001–13	2,754,765	
Credential two-year	Student received a certificate or Associate's degree from a two-year college within 5 years of junior year	2001–13	2,754,765	
Credential two-year or transfer	Student received a certificate or Associate's degree from a two-year college or transferred to a four-year HEI within 5 years of junior year	2001–13	2,754,765	

Outcome	Definition	Cohorts Examined	Number of Students	Conditioning
Graduated four-year	Student completed a Bachelor's degree from a four-year college within 10 years of junior year	2001–08	1,542,629	
Graduated two- or four-year	Student completed an Associate's degree from a two-year college or a Bachelor's degree from a four-year college within 10 years of junior year	2001–08	1,542,629	
Credential 2- or four-year	Student received a certificate or Associate's degree from a two-year college or a Bachelor's degree from a four-year college within 10 years of junior year	2001–08	1,542,629	
Time to four-year Degree	Years between graduating high school and completing a Bachelor's degree from four-year college	2001–08	375,715	Conditioned on graduating from four-year school
Credit to four-year Degree	SCH earned at all institutions prior to obtaining the first Bachelor's degree	2001–08	384,658	Conditioned on graduating from four-year school
Credit in College to four-year Degree	SCH earned at all institutions after graduating from high school and prior to obtaining the first Bachelor's degree	2001–08	384,658	Conditioned on graduating from four-year school

Descriptive Statistics

First Analytic File

Table AE.3 presents descriptive statistics for various time periods and samples used for estimating the causal impact of dual-credit education programs. Statistics show that across all time periods and samples, certain student groups select into dual-credit programs. Columns 1 and 2 in Table AE.3 present descriptive statistics for 2001–2008; Columns 3 and 4 present descriptive statistics for 2001–13; Columns 5 and 6 present descriptive statistics for 2001–2015; and finally Columns 7 and 8 present descriptive statistics for 2001–2016.

This time period is presented because it is the time period used to examine the effect of dual-credit education on college completion from four-year institutions. We also present the statistics for all of the other outcomes in this time period. It gives the percentages of characteristics like race and academic information broken down into two groups: those who took DC and those who do not. We compare DC and non-DC students based on four outcome windows. Graduation from four-year institutions is defined for junior cohorts 2001–2008, graduation from two-year institutions is defined for junior cohorts 2001–2013, enrollment is defined for junior cohorts 2001–2015, and high school graduation is defined for junior cohorts 2001–2016.

Table A.3. Summary Statistics

Variables	Junior Cohorts							
	2001–08		2001–13		2001–15		2001–16	
	No DC	DC	No DC	DC	No DC	DC	No DC	DC
White	47.9%	61.5%	42.7%	55.6%	41.2%	54.8%	40.5%	54.4%
African American	13.9%	6.5%	14.1%	7.1%	14.1%	7.1%	14.1%	7.2%
Asian	3.1%	3.6%	3.3%	3.7%	3.3%	3.7%	3.2%	3.6%
Hispanic	34.8%	28.2%	39.0%	32.5%	40.4%	33.1%	41.0%	33.5%
Other Race	0.3%	0.3%	0.8%	0.9%	0.9%	1.0%	1.0%	1.1%
Male	49.3%	41.5%	50.1%	41.9%	50.3%	42.0%	50.4%	42.0%
Free/Reduced Lunch	34.7%	23.5%	40.4%	28.4%	41.9%	28.9%	42.6%	29.4%
At Risk	46.9%	20.4%	48.8%	21.0%	49.8%	21.3%	50.2%	21.5%
ESL	1.4%	0.1%	1.9%	0.2%	2.2%	0.3%	2.4%	0.3%
Gifted	11.1%	28.3%	10.2%	25.1%	9.8%	24.3%	9.4%	23.6%
Grad HS	79.8%	94.3%	79.7%	94.5%	80.3%	94.6%	80.3%	94.5%
Enroll two-year	30.2%	31.0%	29.9%	31.8%	29.6%	31.8%		
Enroll four-year	18.8%	45.8%	17.6%	44.2%	17.2%	44.1%		
Enroll four- or two-year	47.4%	72.9%	46.0%	72.2%	45.4%	72.0%		
Grad two-year	2.2%	5.2%	2.4%	6.3%				
Certificate two-year	1.1%	1.5%	1.1%	2.0%				
Credential two-year	3.2%	6.4%	3.3%	7.9%				
Credential two-year or Transfer	16.3%	27.9%	14.4%	26.2%				
Grad four-year	19.9%	51.5%						
Grad two- or four-year	20.9%	53.6%						
Credential two- or four-year	21.8%	54.7%						

Causal Impact Study: Methods and Results

In this section, we describe the quasi-experimental methods used to estimate the causal impact of dual-credit education programs in Chapter 1. We also present detailed findings and regression output.

First, we describe our identification strategy using an instrumental variable approach and why using an instrumental variable strategy is necessary in this setting, along with the necessary identifying assumptions. Then we present our results in terms of the average effect of dual-credit education, the dosage effect of dual-credit education, and the heterogeneous effects of dual-credit education.

Identification Strategy

As documented in Phase I as well as Table AE.3, students who decide to enroll in dual-credit education are different across many dimensions from students who do not participate in dual-credit education, including race, gender, economic status, and academic preparation. While we can control for these observable characteristics, it is likely that these students differ on unobservable characteristics like motivation, future aspirations, work ethic, among others. Hence, even when only controlling for observable characteristics like race/ethnicity, income, and academic preparation, results estimating the effect of dual-credit on student outcomes will likely be biased because factors like motivation will also likely affect how well a student performs in high school and college.

To address this issue, we employ a quasi-experimental approach for causal inference called instrumental variables estimation (IV). In this approach, we predict dual-credit status using a variable (the instrument) that is uncorrelated with the educational outcomes we examine but is correlated with dual-credit status, and then use the fitted values from that regression to predict the outcome of interest. In doing so, this approach uses only the variation in DC that is driven by differences in the instrument to predict the outcome of interest. In our case, we use as our instrument the percentage of other students in a school taking dual-credit, a measure of implementation of DC within the school, to predict a student's dual-credit status when looking at average effect. Thus, our analysis uses only the variation in DC participation that is driven by differences in DC implementation over time and across schools to assess the impact of DC participation on student outcomes. Such variation is less problematic because students are unlikely to choose schools based on the extent to which have implemented DC programs. We show that our instrument is highly related to DC participation, or it has a "strong first stage." Our identifying assumption in these models is that, conditional on the student characteristics

we include in the model and all time constant factors at the high school level, a student's future educational outcomes are uncorrelated with the percentage of other students in her junior cohort taking dual-credit in a high school.

Empirical Models

We run three models using our IV approach to assess the causal impact of DC education. First, we examine the average effect of DC education, then we look at the dosage effect of DC education, and finally, we examine the heterogeneous effects of DC education. To assess the average effect of DC education, we instrument for a student taking any DC education with the DC participation rate of other students in the same cohort at the same high school. For the dosage effect, we instrument for a student taking DC SCH with the average DC SCH taken by other students in the same cohort at the same high school. Last, to assess the heterogeneous effects we run similar models to the average effects model, but we include an interaction term between DC education and various student characteristics. We instrument for DC taking with the DC participation rate of other students in the same cohort at the same high school, and we instrument for the interaction term by interacting the participation rate of other students with the same student characteristic as the endogenous variable.

The Average Effect of Enrolling in Dual-Credit Education

Our first stage for the average effects model is presented below:

$$DC_{it} = \alpha_1 \%DC_{th,-i} + \alpha_2 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

Where DC_{it} is an indicator for if student i in junior cohort t took DC in their junior or senior year. $\%DC_{th,-i}$ is the percentage of students at high school h in cohort t taking dual-credit excepting student i. X_i is a matrix of student characteristics. We also include high school fixed effects μ_h and junior year cohort fixed effects τ_t to control for time-invariant factors within a high school or junior cohort. Regression output for each first stage regression using each of the sets of junior cohorts employed for different analyses is displayed below suppressing the values except for $\%DC_{th,-i}$:

Table A.4. First Stage for Average Effects

Variables	(1) Took DC	(2) Took DC	(3) Took DC	(4) Took DC	(5) Took DC
DC participation in HS	3.732***	3.657***	3.630***	3.593***	6.219***
	(0.0405)	(0.0354)	(0.0355)	(0.0357)	(0.109)
Junior Cohorts	2001–08	2001–13	2001–15	2001–15	2001–08
F-Statistic	594.1	817.6	846.3	843.9	241.9
Limited Sample					X
Observations	1,542,629	2,754,765	3,223,430	3,411,286	384,658
R-squared	0.247	0.243	0.241	0.240	0.342

Column 1 gives the first stage for examining four-year higher education outcomes: graduation four-year, graduation two- or four-year, and credential two- or four-year. Column 2 gives the first stage for examining two-year higher education outcomes: graduation two-year, certificate two-year, credential two-year, and credential two-year or transfer to four-year. Column 3 gives the first stage for enrolling in higher education: enroll two-year, enroll four-year, and enroll two- or four-year. Column 4 gives the first stage for if a student graduates from high school. Finally, Column 5 gives the first stage for the degree completion where the regression is conditional on a student graduating from a four-year institution.

Results from the first stage model clearly suggest that our instrument is relevant for estimating whether a student took dual-credit in high school. Typically, a strong first stage has an F-statistic greater than 30, which is clearly satisfied using this instrument. The first stage regressions have F-statistics greater than 500 for all specifications except for the last first stage displayed, which has a value of 242. The first stage also suggests a positive relationship between the instrument and taking dual-credit, which is what one would intuitively expect.

Our second stage for the average effects model is presented below:

$$Y_{ith} = \beta_1 \widehat{DC_{it}} + \beta_2 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

Where Y_{ith} is the educational outcomes for student i. The notation for the second stage is the same as the first stage. The regression output is displayed below:

Table A.5. Second Stage for Average Effects

	OLS Estimate of DC	Reduced Form Effect	IV estimate of DC	Observations	Junior Cohorts
Panel A - Short Term Academic Outcomes					
HS Grad	0.0892***	0.0235	0.00641	3,411,286	2001-2016
	(0.00142)	(0.0254)	(0.00698)		
Enroll two-year	0.0385***	0.0594*	0.0164*	3,223,430	2001-2015
	(0.00273)	(0.0312)	(0.00857)		
Enroll four-year	0.199***	0.0244	0.00671	3,223,430	2001-2015
	(0.00277)	(0.0387)	(0.0107)		
Enroll two- or four-year	0.217***	0.0869**	0.0239***	3,223,430	2001-2015
	(0.00297)	(0.0337)	(0.00925)		
Panel B - Long Term Academic Outcomes					
Graduation two-year	0.0293***	0.0328***	0.00896***	2,754,765	2001-2013
	(0.00107)	(0.00961)	(0.00263)		
Certificate two-year	0.00723***	0.0592***	0.0162***	2,754,765	2001-2013
	(0.000847)	(0.00868)	(0.00238)		
Credential two-year	0.0345***	0.0798***	0.0218***	2,754,765	2001-2013
	(0.00138)	(0.0130)	(0.00354)		
Credential two-year or Transfer	0.0954***	0.130***	0.0355***	2,754,765	2001-2013
	(0.00229)	(0.0270)	(0.00735)		
Graduation four-year	0.209***	0.0129	0.00345	1,542,629	2001-2008
	(0.00318)	(0.0300)	(0.00802)		
Graduation two- or four-year	0.217***	0.0295	0.00790	1,542,629	2001-2008
	(0.00316)	(0.0304)	(0.00812)		
Credential two- or four-year	0.218***	0.0421	0.0113	1,542,629	2001-2008
	(0.00310)	(0.0308)	(0.00824)		
Panel C - Degree Completion					
Credit to Degree	2.255***	26.67***	4.199***	384,658	2001-2008
	(0.285)	(5.569)	(0.892)		
Credit in College to Degree	-7.017***	-48.84***	-7.774***	384,658	2001-2008
	(0.315)	(5.852)	(0.921)		
Time to Degree	-0.318***	-0.510***	-0.0803***	375,715	2001-2008
	(0.00766)	(0.125)	(0.0196)		

	OLS Estimate of DC	Reduced Form Effect	IV estimate of DC	Observations	Junior Cohorts
Panel D - Limited Sample of Panel A					
HS Grad	0.0855***	0.0663	0.0178	1,542,629	2001-2008
	(0.00203)	(0.0454)	(0.0122)		
Enroll two-year	0.0231***	0.0741**	0.0199**	1,542,629	2001-2008
	(0.00387)	(0.0350)	(0.00941)		
Enroll four-year	0.208***	0.00926	0.00248	1,542,629	2001-2008
	(0.00340)	(0.0376)	(0.0101)		
Enroll two- or four-year	0.210***	0.0627	0.0168	1,542,629	2001-2008
	(0.00401)	(0.0427)	(0.0114)		
Panel E - Limited Sample of Panel A					
HS Grad	0.0956***	-0.0562	-0.0195	1,680,767	2009-2015
	(0.00163)	(0.0377)	(0.0131)		
Enroll two-year	0.229***	0.112***	0.0199	1,680,767	2009-2015
	(0.00299)	(0.0412)	(0.0138)		
Enroll four-year	0.199***	-0.00877	-0.00304	1,680,767	2009-2015
	(0.00284)	(0.0346)	(0.0120)		
Enroll two- or four-year	0.0518***	0.0574	0.0389***	1,680,767	2009-2015
	(0.00270)	(0.0401)	(0.0142)		
Panel F - Graduation Windows					
Grad four-year within 6yrs of 11th Grade	0.120***	0.0969***	0.0260***	1,989,304	2001-2010
	(0.00242)	(0.0155)	(0.00415)		
Grad four-year within 7yrs of 11th Grade	0.176***	0.0519**	0.0139**	1,989,304	2001-2010
	(0.00299)	(0.0226)	(0.00604)		
Grad four-year within 8yrs of 11th Grade	0.193***	0.0340	0.00914	1,989,304	2001-2010
	(0.00292)	(0.0252)	(0.00676)		

For our results, we present the OLS estimates of the effect of dual-credit education and compare them against our IV estimates to show the degree of bias resulting from self-selection into dual-credit courses. This is accentuated by the IV estimate being smaller in magnitude for most of the outcomes. For instance, the OLS estimate for graduating from a four-year college suggests that enrolling in dual-credit programs increases a student's likelihood of enrolling in college by 21.7 percentage points, but the IV estimates suggest dual-credit increases the likelihood by 2.4 percentage points.

We also present the reduced form estimates from our model. The reduced form estimate gives the effect of our instrument, $\%DC_{th,-i}$, on the outcomes of interest like enrollment and graduation. The reduced form estimates illuminate where the IV estimates are coming from because the IV estimates are derived by dividing the reduced form estimates by the first stage estimate. For example, the reduced form estimate on enrolling in college out of high school is 0.0869, and if one were to divide that by the first stage estimate in Table A.4, column (3), which is 3.630 then one recovers the IV estimate of 0.0239. Given that our first stage is greater than 1 for each specification, the reduced form estimates will always be larger than our IV estimates. The interpretation of the reduced form coefficient on enrolling, 0.0869, would be if everyone in a school enrolled in DC, then college enrollment after high school would increase by 8.69 percentage points.

High School Graduation, College Enrollment and Completion

Panel A shows the impact of dual-credit education on short-term educational outcomes (e.g., high school graduation). Our IV estimates show that dual-credit education has a positive effect on enrolling in a two-year college as well as enrolling in any college within two years of their junior year in high school, but we find no significant effect on enrolling in four-year schools. We also find no statistically significant effect of DC participation on high school graduation.

In Panel B, we look at long-term education outcomes (e.g., college completion) and find that dual-credit education positively impacts a student's likelihood of earning an Associate's degree by 0.9 percentage points, earning a two-year certificate by 1.6 percentage points, and earning any credential from a two-year school or having an upward transfer by 3.6 percentage points. DC education had an insignificantly positive effect on four-year outcomes. Similar to what we saw in Panel A, the largest coefficients were concentrated in outcomes from two-year schools. This is not surprising since most of dual-credit is delivered by community colleges, so one might expect that the effects would be seen the strongest in two-year colleges.

Credits to Degree, Time to Degree

In Panel C, we examine the effect of dual-credit education on how many total credits (including those earned through dual-credit programs) a student took to complete a four-year degree, how many credits a student took in college to complete a four-year degree, and time to complete a four-year degree. We conditioned these regressions on a student graduating from a four-year college because a student's credit or time to a degree would be undefined otherwise. Results show that enrolling in dual-credit education increases the total amount of credits a student graduates with by approximately 4 credits, but it reduces the amount of credits taken

in college by about 8 credits. We also find that dual-credit education decreases time to competition by about a month, or the first or second summer term, on average.

Timing of Taking DC for Short-term Outcomes

In Panel D and E, we split the sample in half to examine how the effect of DC changed over time for students. Panel D presents the effect of DC education on high school graduation and enrollment for junior cohorts 2001–08, and Panel E presents the effect of DC on the same outcomes for junior cohorts 2009–15. In Panel D, we find that there is a significant effect of DC increasing the likelihood of enrolling in a two-year college on-time by 2.0 percentage points. We find the same point estimate in Panel E, but it is insignificant, suggesting that there is less precision in the estimate. We find insignificantly positive effects from DC education for the rest of the outcomes in Panel D. In Panel E, there's only a significant effect from DC education increasing the likelihood of enrolling on-time in any higher education institution by 3.9 percentage points. The results in Panel D and E suggest that there is the effect on enrolling in two-year institution is the same over time, but the variance has been increasing over time, resulting in a less precise estimate in Panel E. There's also has been an increase in the effect of DC education on enrolling in any college over time.

On-Time Graduation

Panel F measures the effect of dual-credit education on graduating from college on time. As we reported earlier in this appendix, we follow students for 10 years after the start of their junior year to observe if they completed a four-year degree. For this analysis, we follow juniors for 6 years, 7 year, and 8 years starting with their junior year to observe the same outcome. Results from Panel F show that the effect of dual-credit education on the completion of a four-year degree becomes smaller as the window of time becomes wider. Specifically, we find that dual-credit education increases the likelihood of graduating from a four-year college within 6 years significantly by 2.6 percentage points; within 7 years significantly by 1.4 percentage points; within 8 years insignificantly by 0.9 percentage points, and within 10 years insignificantly by 0.3 percentage points. These results suggest dual-credit education gives an advantage that becomes smaller over time as non-dual-credit students are able to catch up. These results are consistent with our findings that DC education increases time to completion.

The Effect of the Dosage of Dual-Credit Education

Our previous section provides the average effect of enrolling in any amount of dual-credit education. However, the effect of enrolling in dual-credit education may vary depending on the amount of dual-credit SCH students take. To answer this question, we estimate the effect of a

single DC SCH on student outcomes using OLS. We instrument for the amount of dual-credit SCH that a student takes with the average amount of DC SCH in a given high school taken by the other students.

Empirical Models

The first stage equation for the dosage model is below:

$$DC\_SCH_{it} = \alpha_1 \overline{DC\_SCH_{ht,-\iota}} + \alpha_2 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

Where DC_SCH_{it} is the amount of dual-credit SCH taken by student i in cohort t. $\overline{DC\_SCH_{ht,-\iota}}$ gives the average dual-credit SCH taken at high school h taken by students other than student i in cohort t. X_i is a matrix of observable student characteristics. We also include high school fixed effects μ_h and junior year cohort fixed effects τ_t to control for time-invariant factors within a high school or junior cohort. Regression output is displayed below suppressing the values except for $\overline{DC\_SCH_{ht,-\iota}}$

Table A.6. First-Stage for Dosage Effects

Variables	(1) DC SCH	(2) DC SCH	(3) DC SCH	(4) DC SCH	(5) DC SCH
Average DC SCH at HS	3.896***	3.726***	3.621***	3.503***	7.618***
	(0.0435)	(0.0356)	(0.0370)	(0.0381)	(0.159)
Junior Cohorts	2001–08	2001–13	2001–15	2001–15	2001–08
F-Statistic	498.7	709.8	654.52	583.4	162.5
Limited Sample					X
Observations	1,542,629	2,754,765	3,223,430	3,411,286	384,658
R-squared	0.264	0.278	0.277	0.274	0.421

Column 1 gives the first stage for examining four-year higher education outcomes: graduation four-year, graduation 2- or four-year, and credential four-year. The Column 2 gives the first stage for examining two-year higher education outcomes: graduation two-year, certificate two-year, credential two-year, and credential two-year or transfer to four-year. Column 3 gives the first stage for enrolling in higher education: enroll two-year, enroll four-year, enroll two- or four-year. Column 4 gives the first stage for if a student graduates from high school. Finally, Column 5 gives the first stage for the degree completion where the regression is conditional on a student graduating from a four-year institution.

Results from the first stage model clearly suggests that our instrument is relevant for estimating how much a student took dual-credit in high school. Typically, a strong first stage has a F-statistic greater than 30, which is clearly satisfied using this instrument. The first stage regressions have F-statistics greater than 500 for all specifications except for the last first stage displayed, which has a value of 162.5. The first stage also suggests a positive relationship between the instrument and taking dual-credit SCH, which is what one would intuitively expect. The first stage for the dosage effects looks similar to the first stage for the average effects.

Our second stage equation for the dosage model is presented below:

$$Y_{ith} = \beta_1 \widehat{DC\_SCH}_{it} + \beta_2 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

Where Y_{ith} is the educational outcomes for student i. The notation for the second stage is the same as the first stage. The regression output is displayed below:

Table A.7. Second Stage for Dosage Effects

	OLS	Reduced Form	IV		IV	
	DC Credit SCH	Avg DC SCH	DC Credit SCH	Mean DC SCH of DC Takers	DC Effect At Mean	Observations
Panel A - Short Term Academic Outcomes						
HS Grad	0.00518***	0.000899	0.000246	11.39	0.00280	3,411,286
	(0.000113)	(0.00155)	(0.000442)		(0.00503)	
Enroll two-year	0.000596***	-0.00279	-0.000770	11.31	-0.00871	3,223,430
	(0.000179)	(0.00209)	(0.000580)		(0.00657)	
Enroll four-year	0.0137***	0.00612***	0.00169***	11.31	0.0191**	3,223,430
	(0.000239)	(0.00228)	(0.000630)		(0.00712)	
Enroll two- or four-year	0.0129***	0.00337	0.000931	11.31	0.0105	3,223,430
	(0.000262)	(0.00209)	(0.000575)		(0.00651)	
Panel B - Long Term Academic Outcomes						
Graduation two-year	0.00301***	0.00446***	0.00120***	10.98	0.0131***	2,754,765
	(0.000181)	(0.000813)	(0.000217)		(0.00238)	
Certificate two-year	0.000922***	0.00575***	0.00154***	10.98	0.0169***	2,754,765
	(0.000110)	(0.000796)	(0.000209)		(0.00230)	

	OLS	Reduced Form	IV		IV	
Credential two-year	0.00373***	0.00907***	0.00243***	10.98	0.0300***	2,754,765
	(0.000206)	(0.00115)	(0.000303)		(0.00539)	
Credential two-year or Transfer	0.00675***	0.0102***	0.00273***	10.98	0.0300***	2,754,765
	(0.000206)	(0.00186)	(0.000491)		(0.00539)	
Graduation four-year	0.0162***	0.00464**	0.00119**	9.837	0.0117**	1,542,629
	(0.000315)	(0.00225)	(0.000575)		(0.00565)	
Graduation two- or four-year	0.0169***	0.00671***	0.00172***	9.837	0.0169***	1,542,629
	(0.000311)	(0.00234)	(0.000595)		(0.00585)	
Credential two- or four-year	0.0172***	0.00827***	0.00212***	9.837	0.0209***	1,542,629
	(0.000298)	(0.00240)	(0.000611)		(0.00601)	
Panel C - Degree Completion						
Credit to Degree	0.330***	2.555***	0.335***	10.63	3.564***	384,658
	(0.0210)	(0.391)	(0.0515)		(0.547)	
Credit in College to Degree	-0.670***	-5.063***	-0.665***	10.63	-7.065***	384,658
	(0.0210)	(0.415)	(0.0515)		(0.547)	
Time to Degree	-0.0268***	-0.0572***	-0.00740***	10.63	-0.0788***	375,715
	(0.000527)	(0.00935)	(0.00119)		(0.0126)	
Panel D - Limited Sample of Panel A						
HS Grad	0.00598***	0.00297	0.000762	9.837	0.00749	1,542,629
	(0.000150)	(0.00337)	(0.000864)		(0.00850)	
Enroll two-year	6.41e-05	0.00135	0.000346	9.837	0.00341	1,542,629
	(0.000310)	(0.00318)	(0.000818)		(0.00804)	
Enroll four-year	0.0160***	0.00743**	0.00191**	9.837	0.0188**	1,542,629
	(0.000302)	(0.00293)	(0.000745)		(0.00732)	
Enroll two- or four-year	0.0145***	0.00721*	0.00185*	9.837	0.0182*	1,542,629
	(0.000374)	(0.00377)	(0.000964)		(0.00948)	
Panel E - Limited Sample of Panel A						
HS Grad	0.00524***	-0.00334	-0.00117	12.33	-0.0145	1,680,767

	OLS	Reduced Form	IV		IV	
	(0.000130)	(0.00217)	(0.000761)		(0.00939)	
Enroll two-year	0.00100***	0.00280	0.000983	12.33	0.0121	1,680,767
	(0.000174)	(0.00250)	(0.000879)		(0.0108)	
Enroll four-year	0.0131***	-0.00122	-0.000429	12.33	-0.00529	1,680,767
	(0.000250)	(0.00218)	(0.000768)		(0.00948)	
Enroll two- or four-year	0.0128***	-0.000560	-0.000197	12.33	-0.00242	1,680,767
	(0.000275)	(0.00220)	(0.000773)		(0.00954)	
Panel F - Graduation Windows						
Grad four-year within 6yrs of 11th Grade	0.0103***	0.00919***	0.00237***	10.32	0.0244***	1,989,304
	(0.000230)	(0.00112)	(0.000288)		(0.00297)	
Grad four-year within 7yrs of 11th Grade	0.0137***	0.00597***	0.00154***	10.32	0.0159***	1,989,304
	(0.000283)	(0.00160)	(0.000408)		(0.00421)	
Grad four-year within 8yrs of 11th Grade	0.0146***	0.00445**	0.00115**	10.32	0.0118**	1,989,304
	(0.000286)	(0.00179)	(0.000458)		(0.00473)	

Main Results

Similar to the average effects regression output, we present the OLS estimates with the IV estimates for comparison to show the same pattern of positive selection seen in the average effects sections. Similar to the average effects of dual-credit education on student outcomes, we find that for most student outcomes the OLS estimates are larger in magnitude than the IV estimates. To examine the effect of one dual-credit course, which is typically 3 SCH, one would multiply the coefficients given by 3.

We also present the reduced form estimates from our model just as in Table A.5. The reduced form estimate gives the effect of our instrument, $\overline{DC\_SCH_{ht,-\iota}}$, on the outcomes of interest like enrollment and graduation. The IV estimates are derived by dividing the reduced form estimates by the first stage estimate. For example, the reduced form estimate on enrolling in a four-year college out of high school is 0.00612 and if one were to divide that by the first stage estimate in Table A.4, column (3), which is 3.621 then one recovers the IV estimate of 0.00169.

Given that our first stage is greater than 1 for each specification, the reduced form estimates will always be larger than our IV estimates. The interpretation of the reduced form coefficient on four-year enrollment, 0.00612, is if the school averaged one additional DC SCH, then four-year college enrollment after high school would increase by 0.61 percentage points.

Finally, find how the dosage effects map over to the average effects in Table A.5. We give the average DC SCH taken for each cohort for those that enrolled in DC. We take the average DC SCH and multiply that by our IV estimates, which should give of the average dosage effect in our model. These estimates should be similar to our other estimates in Table A.5 if the model is properly specified.

In Panel A, we find that for taking additional DC SCH, a student's chances of enrolling in a four-year university is increased by 0.17 percentage points and statistically significant. However, we find an insignificant effect on enrolling in a two-year, which differs from what we found in the average effects. While the coefficient on enrolling in a four-year college is significant in Table A.7 and not in Table A.5, it is important to recognize that the results are consistent with each other. The average effect in Table A.5 is 0.0067 while the average effect in Table A.7 is 0.0191, but the confidence intervals of the two estimates overlap suggesting that the estimated effect by either method is statistically indistinguishable from one another.

However, the results in Panel B are consistent with the previous results for average effects. In particular, all of the two-year outcomes are significantly positively affected by dual-credit. If one multiplies the IV effects by the average DC SCH taken, then the estimates given by the dosage effect are about the same as the average effect estimates. For example, the average effect of DC education increases the likelihood of getting a certificate from a two-year school by 1.62 percentage points. We find that the effect for taking a 1 DC SCH increases the likelihood of earning a certificate from a two-year school by 0.15 percentage points. The average DC student takes 10.98 DC SCH, so our dosage estimates suggest that the average student would increase the likelihood of earning a certificate from a two-year school by 1.69 percentage points.

The dosage effects differ from the average effects though when examining four-year outcomes. Our dosage model suggests that the four-year outcomes are significantly and positively affected by one additional DC SCH, but DC education has no significant effect on four-year outcomes in our average effect model. However, as we saw in Panel A, the results differ but are consistent with each other. The confidence interval for the average effect of DC on graduation four-year, graduation two- or four-year, or credential from two- or four-year encompasses the estimate

given by the average dosage effect. Panel B in Table A.5 and Table A.7 are statistically indistinguishable from one another.

We find similar effects in Panel C for both dosage and average effects. Our results suggest that DC SCH works as a substitute for credits in college. One additional DC SCH increases the total SCH taken to a four-year degree by 0.335, and it decreases the total credits taken in college to a four-year degree by 0.665. This suggests that DC courses and regular college courses are substitutes but not perfectly.

In Panel D and E, we split the sample in half to see how the effect of DC education changes over time for the dosage effects. In Panel D, we find a significant effect for enrolling in a four-year and any college with an additional DC SCH increasing the likelihood by 0.2 percentage points for both outcomes. We find no significant effect for any outcome examined in Panel E, suggesting that there is a decrease the effect of the dosage in DC SCH.

Panel F gives the effect of DC dosage on graduating from college by different time windows. For this analysis, we follow juniors for 6 years, 7 years, and 8 years starting with their junior year to observe graduation from four-year colleges. Results from Panel F show that the effect of dual-credit education on the completion of a four-year degree becomes smaller as the window of time becomes wider. These results are consistent in terms of sign and magnitude to what we saw in Panel F for the average effects. Specifically, we find that an additional DC SCH increases the likelihood of graduating from a four-year college within 6 years significantly by 0.24 percentage points; within 7 years significantly by 0.15 percentage points; within 8 years insignificantly by 0.12 percentage points, and within 10 years significantly by 0.12 percentage points. To find the average effect, one would multiply these effects by about 10, which is the average amount of DC SCH taken by students participating in DC, then these estimates are similar in magnitude to what we found in the average effects model. These results suggest dual-credit education gives an advantage that becomes smaller over time as non-dual-credit students are able to catch up. These results are consistent with our findings that DC education decreases time to completion.

All of the panels analyzed in Table A.5 and Table A.7 suggest that the two models estimate nearly identical effects. This finding is unsurprising as the reasoning behind the two models are similar, and the first stage results presented in Table A.4 and Table A.6 are also extremely similar. We find more significant effects in Table A.7 than in Table A.5, but this difference is not driven by differences in point estimates, but precision. Our estimates in Table A.5 are much less precise than those in Table A.7.

Heterogeneous Effect of Dual-Credit Education

For this section of the appendix, we examine the average effect of dual-credit education by student sub group. To conduct this analysis, we employed an empirical model similar to the one that examined the average effect of dual-credit education on student outcomes. The only difference is that in this particular model, we included a term that interacts enrolling in dual-credit education with certain student characteristics. Formally, we estimate these equations:

With the first stage equations:

For $j = 1$ to $j = J$:

$$DC_{it} = \alpha_0 \%DC_{th,-i} + \alpha_j \%DC_{th,-i} * x_{ij} + \phi_0 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

$$DC_{it} * x_{ij} = \theta_0 \%DC_{th,-i} + \theta_j \%DC_{th,-i} * x_{ij} + \phi_j X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

IV equations:

For $j = 1$ to $j = J$:

$$Y_{ith} = \beta_0 \widehat{DC_{it}} + \beta_j \widehat{DC_{it} * x_{ij}} + \gamma_1 X_i + \gamma_2 Z_{th} + \mu_h + \tau_t + \varepsilon_{ith}$$

Our notation is the same as the previous equations. X_i is a $Kx1$ vector of observable student-level characteristics such that $K \geq J$. x_{ij} is characteristic j of student i in cohort t. The J characteristics that we interact for are sex, race, normalized eighth-grade test scores and if they are designated by TEA as economically disadvantaged.

β_0 gives the effect of dual-credit for students that lack characteristic j, and β_j gives the differential effect of dual-credit education for student with characteristic j. $\beta_0 + \beta_j$ gives the total effect of dual-credit for students with characteristic j. This differs for normalized eighth-grade test scores since the mean test score gives a value of 0. In this instance, β_0 represents the effect of dual-credit for a student with average eighth-grade test scores, and $\beta_0 + \beta_j$ gives the total effect of dual-credit for students with a test score of one standard deviation higher than the average. We display the total effect for those that do and do not receive free/reduced priced lunch in Table AE.8. We display the effect of DC for students with average eighth-grade test scores and those with a one standard deviation increase in test scores in Table AE.9, and we display the effect of DC by race in Table AE.10.

Disadvantaged Students

We define disadvantaged students as students who are eligible for free or reduced priced lunch. The results show that the impact of dual-credit participation for students who are eligible for free or reduced price lunch is less than that for students who are ineligible, and is negative in most cases. For example, our estimates suggest that dual-credit participation reduces college enrollment by 3.2 percentage points and reduces college completion by 6.7 percentage points for free or reduced-price lunch eligible students. However, we also find that participation in dual-credit increases the likelihood of earning a certificate by 2.1 percentage points for these students.

Table A.8. Heterogeneous Effects of DC for Students Eligible and Ineligible for Free or Reduced-Price Lunch

	(1)	(2)
Variables	**Ineligible for Free or Reduced-Price Lunch**	**Eligible for Free or Reduced-Price Lunch**
Panel A: Short-Term Academic Outcomes		
HS graduation	0.0243***	-0.0257**
	(0.00624)	(0.0106)
Enrollment two-year	0.0205***	0.00874
	(0.00794)	(0.0139)
Enrollment four-year	0.0375***	-0.0497***
	(0.00971)	(0.0144)
Enrollment two- or four-year	0.0545***	-0.0320**
	(0.00977)	(0.0141)
Panel B: Long-Term Academic Outcomes		
Graduate two-year	0.0128***	0.00169
	(0.00267)	(0.00400)
Certificate two-year	0.0136***	0.0210***
	(0.00194)	(0.00372)
Credential two-year	0.0230***	0.0196***
	(0.00333)	(0.00552)
Credential two-year or Transfer	0.0458***	0.0161
	(0.00627)	(0.0122)
Graduate four-year	0.0369***	-0.0736***
	(0.00845)	(0.0152)
Graduate two- or four-year	0.0416***	-0.0697***
	(0.00851)	(0.0154)
Credential two- or four-year	0.0452***	-0.0669***
	(0.00864)	(0.0156)

	(1)	(2)
Panel C: Degree Completion		
Credit to Degree	4.711***	2.313
	(0.911)	(1.430)
Credit in College to Degree	-7.442***	-9.774***
	(0.933)	(1.482)
Time to Degree	-0.0746***	-0.111***
	(0.0196)	(0.0361)
Panel D: Limited Sample of Panel A		
HS Grad	0.0388***	-0.0307
	(0.0105)	(0.0197)
Enroll two-year	0.0289***	-0.000962
	(0.00928)	(0.0164)
Enroll four-year	0.0247**	-0.0487**
	(0.00974)	(0.0176)
Enroll two- or four-year	0.0451***	-0.0483***
	(0.0113)	(0.0208)
Panel E: Other Limited Sample of Panel A		
HS Grad	0.0142	-0.0588***
	(0.0108)	(0.0170)
Enroll two-year	0.0622***	0.0116
	(0.0132)	(0.0182)
Enroll four-year	0.0503***	-0.0654***
	(0.0116)	(0.0159)
Enroll two- or four-year	0.0952***	-0.0682***
	(0.0138)	(0.0191)
Panel F: Graduation Windows		
Grad four-year within 4 yrs of HS	0.0513***	-0.0255***
	(0.00440)	(0.00666)
Grad four-year within 5 yrs of HS	0.0446***	-0.0484***
	(0.00656)	(0.0103)
Grad four-year within 6 yrs of HS	0.0416***	-0.0570***
	(0.00727)	(0.0115)

High Achieving Students

We find nearly universally significantly positive effects from dual-credit education on high-achieving students. Students who score one standard deviation above the average on

standardized tests in eighth-grade reading and mathematics have significantly positive effects for nearly all outcomes. It is also notable for these high achieving students that dual-credit seems to more positively affect outcomes related four-year graduation and enrollment instead of two-year graduation and enrollment. This differs from the average effect from dual-credit education which showed larger effects for outcomes related to two-year colleges like enrolling in two-year college and graduating from two-year colleges. Students that have high tests scores on reading, one standard deviation above the mean score, are 5.8 percentage points more likely to enroll in any college and 5.3 percentage points to graduate from any college. The results are similar for mathematics test scores with DC positively affecting enrollment and completion by 4.2 and 3.3 percentage points, respectively.

Participating in dual-credit education decreased college completion overall by 3.2 percentage points for students with average eight grade standardized test scores in reading, while the effect for students with average mathematics scores was negative but statistically insignificant. At the same time, dual-credit participation also increased high school completion by 1.8 percentage points for students with average eighth grade reading scores, and increased completion or upward transfer from two-year colleges by about 3.9 percentage points for students with average standardized test scores in both reading and mathematics. Students with average reading and mathematics eighth-grade test scores also graduate more quickly after taking DC education than their peers with higher test scores. A possible explanation for this finding is that higher ability students might be less likely to be able to transfer dual-credit courses to their particular major. On average, students with average reading scores graduate 0.17 years (62 days) more quickly following DC education compared with students with reading scores one standard deviation above the mean, who graduate 0.04 years (15 days) more quickly following DC education.

Table A.9. Heterogeneous Effects of DC for Students by Eighth-Grade Test Scores

	(1)	(2)	(3)	(4)
Variables	**Avg. Reading Score**	**+1 Std. Dev. Above Avg. Reading Score**	**Avg. Mathematics Score**	**+1 Std. Dev. Above Avg. Mathematics Score**
Panel A: Short-Term Academic Outcomes				
HS graduation	0.0183*	-0.00858	0.0121	0.000544
	(0.0107)	(0.00552)	(0.00975)	(0.00546)
Enrollment two-year	0.0123	0.0212**	0.0197	0.0130*
	(0.0139)	(0.00888)	(0.0122)	(0.00783)
Enrollment four-year	-0.0220	0.0410***	-0.0182	0.0319***
	(0.0153)	(0.00907)	(0.0141)	(0.00873)
Enrollment two- or four-year	-0.00474	0.0582***	0.00578	0.0423***
	(0.0137)	(0.00847)	(0.0126)	(0.00837)
Panel B: Long-Term Academic Outcomes				
Graduate two-year	-0.00585	0.0260***	-0.00242	0.0201***
	(0.00398)	(0.00286)	(0.00366)	(0.00273)
Certificate two-year	0.0283***	0.00226	0.0244***	0.00818***
	(0.00366)	(0.00167)	(0.00332)	(0.00167)
Credential two-year	0.0184***	0.0257***	0.0186***	0.0250***
	(0.00540)	(0.00328)	(0.00496)	(0.00318)
Credential two-year or Transfer	0.0393***	0.0311***	0.0385***	0.0326***
	(0.0112)	(0.00661)	(0.0103)	(0.00653)
Graduate four-year	-0.0411***	0.0469***	-0.0227*	0.0255***
	(0.0134)	(0.00786)	(0.0120)	(0.00731)
Graduate two- or four-year	-0.0406***	0.0553***	-0.0214*	0.0326***
	(0.0136)	(0.00791)	(0.0122)	(0.00743)
Credential two- or four-year	-0.0315**	0.0530***	-0.0141	0.0327***
	(0.0137)	(0.00796)	(0.0122)	(0.00750)
Panel C: Degree Completion				
Credit to Degree	-1.615	6.999***	-1.864	6.002***
	(1.488)	(0.889)	(1.293)	(0.861)
Credit in College to Degree	-11.67***	-6.101***	-11.65***	-6.796***
	(1.477)	(0.934)	(1.307)	(0.896)
Time to Degree	-0.170***	-0.0406**	-0.164***	-0.0583***
	(0.0318)	(0.0192)	(0.0278)	(0.0189)

	(1)	(2)	(3)	(4)
Panel D: Limited Sample of Panel A				
HS Grad	-0.00418	0.0392***	0.00240	0.0308***
	(0.0213)	(0.00807)	(0.0186)	(0.00844)
Enrollment two-year	0.00679	0.0326***	0.0135	0.0252***
	(0.0170)	(0.0107)	(0.0148)	(0.00901)
Enrollment four-year	-0.0230	0.0274***	-0.0107	0.0136***
	(0.0169)	(0.00929)	(0.0151)	(0.00857)
Enrollment two- or four-year	-0.0194	0.0522***	-0.00104	0.0319
	(0.0198)	(0.0106)	(0.0173)	(0.0101)
Panel E: Other Limited Sample of Panel A				
HS Grad	-0.0263	-0.00722	-0.0276*	-0.00756
	(0.0173)	(0.00813)	(0.0164)	(0.00935)
Enrollment two-year	0.0400**	0.0369***	0.0478***	0.0258**
	(0.0184)	(0.0128)	(0.0175)	(0.0123)
Enrollment four-year	-0.0433***	0.0688***	-0.0389**	0.0493***
	(0.0159)	(0.0118)	(0.0151)	(0.0115)
Enrollment two- or four-year	-0.0205	0.0920***	-0.00782	0.0603***
	(0.0185)	(0.0112)	(0.0174)	(0.0117)
Panel F: Graduation Windows				
Grad four-year within 4 yrs of HS	-0.0120*	0.0680***	-0.00577	0.0561***
	(0.00643)	(0.00530)	(0.00582)	(0.00488)
Grad four-year within 5 yrs of HS	-0.0255***	0.0574***	-0.0158*	0.0421***
	(0.00947)	(0.00690)	(0.00857)	(0.00628)
Grad four-year within 6 yrs of HS	-0.0290***	0.0513***	-0.0190**	0.0358***
	(0.0104)	(0.00720)	(0.00945)	(0.00664)

Race/Ethnicity

We also run the models by race/ethnicity and find significant positive effects for Hispanic and Black students on enrolling in a two-year college or in enrolling in any college. DC education increases the likelihood of on-time enrollment at a two-year college for Black and Hispanic students by 4.7 and 4.3 percentage points, respectively. There is also a positive effect on long-term outcomes for Hispanic students for two-year colleges. After taking dual-credit education, Hispanic students are more likely to graduate or earn a certificate from a two-year college as well as more likely to have a transfer to a four-year college. However, we do not find this effect for Black students, who appear to be less likely to graduate from a two-year school following dual-credit education. Dual-credit education does not appear to significantly affect four-year college outcomes for Black and Hispanic

students. Hispanic students that take DC education also appear to graduate from four-year colleges at a faster rate, reducing their time to degree by 0.17 years or 62 days.

Table A.10. Heterogenous Effects of DC for Students by Race

	(1)	(2)	(3)	(4)	(5)
Variables	**Asian**	**Black**	**Hispanic**	**Other Race**	**White**
Panel A: Short-Term Academic Outcomes					
HS graduation	-0.0349	0.0243	0.00203	0.0180	0.00898
	(0.0228)	(0.0170)	(0.00943)	(0.0170)	(0.00672)
Enrollment two-year	-0.0828***	0.0474**	0.0433***	0.000829	-0.00184
	(0.0293)	(0.0200)	(0.0122)	(0.0213)	(0.00795)
Enrollment four-year	-0.0791***	-0.00309	-0.00352	0.0138	0.0199*
	(0.0298)	(0.0208)	(0.0140)	(0.0228)	(0.0101)
Enrollment two- or four-year	-0.135***	0.0466**	0.0451***	0.0278	0.0139
	(0.0360)	(0.0194)	(0.0127)	(0.0228)	(0.00994)
Panel B: Long-Term Academic Outcomes					
Graduate two-year	0.0164	-0.0185***	0.0157***	0.00961	0.00785***
	(0.0164)	(0.00477)	(0.00385)	(0.0105)	(0.00254)
Certificate two-year	0.00473*	-0.000627	0.0270***	0.0113**	0.0118***
	(0.00280)	(0.00362)	(0.00392)	(0.00555)	(0.00195)
Credential two-year	0.0203	-0.0195***	0.0388***	0.0205*	0.0161***
	(0.0165)	(0.00594)	(0.00556)	(0.0120)	(0.00310)
Credential two-year or Transfer	-0.0731***	-0.00501	0.0543***	0.0145***	0.0339***
	(0.0272)	(0.0122)	(0.0111)	(0.0197)	(0.00611)
Graduate four-year	-0.110***	-0.0124	-0.0119	-0.0311	0.0187**
	(0.0306)	(0.0229)	(0.0127)	(0.0397)	(0.00884)
Graduate two- or four-year	-0.108***	-0.0175	-0.00564	-0.00257	0.0232***
	(0.0304)	(0.0225)	(0.0127)	(0.0414)	(0.00888)
Credential two- or four-year	-0.107***	-0.0233	-0.000737	-0.0114	0.0270***
	(0.0300)	(0.0227)	(0.0128)	(0.0420)	(0.00900)
Panel C: Degree Completion					
Credit to Degree	7.821***	2.884	3.854***	-5.074	4.393***
	(2.790)	(2.574)	(1.457)	(6.658)	(0.939)

	(1)	(2)	(3)	(4)	(5)
Credit in College to Degree	-5.563**	-7.325***	-8.590***	-16.31**	-7.729***
	(2.574)	(2.566)	(1.442)	(6.648)	(0.969)
Time to Degree	0.0779	-0.0537	-0.165***	-0.336**	-0.0626***
	(0.0601)	(0.0492)	(0.0316)	(0.157)	(0.0198)
Panel D: Limited Sample of Panel A					
HS Grad	0.0124	-0.00987	-0.00878	0.0438	0.0360***
	(0.0182)	(0.0380)	(0.0168)	(0.0371)	(0.00999)
Enrollment two-year	-0.0964***	-0.00122	0.0311***	0.0534	0.0205**
	(0.0271)	(0.0258)	(0.0155)	(0.0427)	(0.00923)
Enrollment four-year	-0.0924***	-0.000180	0.00202	-0.00589	0.00695
	(0.0288)	(0.0275)	(0.0155)	(0.0369)	(0.00983)
Enrollment two- or four-year	-0.162***	-0.00757	0.0279	0.0494	0.0205*
	(0.0357)	(0.0264)	(0.0178)	(0.0467)	(0.0114)
Panel E: Other Limited Sample of Panel A					
HS Grad	-0.0326	0.0139	-0.0314**	-0.0209	-0.0112
	(0.0360)	(0.0204)	(0.0155)	(0.0215)	(0.0119)
Enrollment two-year	-0.0664	0.0583**	0.0385**	0.0186	0.0444***
	(0.0423)	(0.0272)	(0.0172)	(0.0259)	(0.0133)
Enrollment four-year	-0.0633*	-0.0430*	-0.00988	-0.0246	0.0239*
	(0.0372)	(0.0235)	(0.0146)	(0.0252)	(0.0122)
Enrollment two- or four-year	-0.136***	0.00387	0.0116	-0.00476	0.0508***
	(0.0504)	(0.0278)	(0.0169)	(0.0263)	(0.0137)
Panel F: Graduation Windows					
Grad four-year within 4 yrs of HS	-0.00212	0.00205	-0.00355	0.0326	0.0485***
	(0.0186)	(0.00966)	(0.00613)	(0.0216)	(0.00474)
Grad four-year within 5 yrs of HS	-0.0617**	0.00189	-0.00786	0.0280	0.0319***
	(0.0257)	(0.0144)	(0.00879)	(0.0271)	(0.00702)
Grad four-year within 6 yrs of HS	-0.0906***	0.00151	-0.00601	0.00782	0.0236***
	(0.0276)	(0.0162)	(0.00976)	(0.0286)	(0.00764)

Taken together, these results suggest that dual-credit can be an effective policy for some students. It benefits high-achieving students almost universally, and it can help disadvantaged students in some respects.

Effect of Dual Credit Participation for Free or reduced-price Lunch Eligibility by Academic Preparation

To further probe the impact of dual-credit participation for free or reduced-price lunch eligible students, we examined how the intersection of a student's eligibility for free/reduced price lunch and eighth grade test scores affects student outcomes. We alter the heterogeneous effects model by including more interaction terms in our regression. Formally, we estimate these equations

With the first stage equations:

$$DC_{it} = \alpha_0 \%DC_{th,-i} + \alpha_1 \%DC_{th,-i} * Free_i + \alpha_2 \%DC_{th,-i} * Score_i + \alpha_3 \%DC_{th,-i} * Free_i * Score_i + \phi_0 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

$$DC_{it} * Free_i = \theta_0 \%DC_{th,-i} + \theta_1 \%DC_{th,-i} * Free_i + \theta_2 \%DC_{th,-i} * Score_i + \theta_3 \%DC_{th,-i} * Free_i * Score_i + \phi_0 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

$$DC_{it} * Score_i = \psi_0 \%DC_{th,-i} + \psi_1 \%DC_{th,-i} * Free_i + \psi_2 \%DC_{th,-i} * Score_i + \psi_3 \%DC_{th,-i} * Free_i * Score_i + \phi_0 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

$$DC_{it} * Free_i * Score_i = \delta_0 \%DC_{th,-i} + \delta_1 \%DC_{th,-i} * Free_i + \delta_2 \%DC_{th,-i} * Score_i + \delta_3 \%DC_{th,-i} * Free_i * Score_i + \phi_0 X_i + \mu_h + \tau_t + \varepsilon_{ith}$$

IV equations:

$$Y_{ith} = \beta_0 \widehat{DC_{it}} + \beta_1 \widehat{DC_{it} * Free_i} + \beta_2 \widehat{DC_{it} * Score_i} + \beta_2 \widehat{DC_{it} * Free_i * Score_{iJ}} + \gamma_1 X_i + \gamma_2 Z_{th} + \mu_h + \tau_t + \varepsilon_{ith}$$

Our notation is the same as the previous equation with two exceptions. $Free_i$ is an indicator for if student i is eligible for free/reduced price lunch, and $Score_i$ is the normalized eighth-grade mathematics or reading score for student i. The interpretation of these coefficients is that β_0 represents the effect of dual-credit for a student that is not eligible for free/reduced price lunch with average eighth-grade test scores, $\beta_0 + \beta_1$ represents the effect of dual-credit for a student that is eligible for free/reduced price lunch with average eighth-grade test scores, $\beta_0 + \beta_2$ represents the effect of dual-credit for a student that is not eligible for free/reduced price lunch with a test score of one standard deviation higher than the average, and finally, $\beta_0 + \beta_1 + \beta_2 + \beta_4$ represents the effect of dual-credit for a student that is eligible for free/reduced

price lunch with a test score of one standard deviation higher than the average. We display these combined coefficients in Table A.11.

Table A.11. Heterogeneous Effects of DC for Students by Eligibility for Free/Reduced Price Lunch and Eighth-Grade Reading Test Scores

	Ineligible for Free/Reduced Price Lunch		Eligible for Free/Reduced Price Lunch	
	Avg Eighth Grade Reading Score	+1 Std. Dev. Above Avg Reading Score	Avg Eighth Grade Reading Score	+1 Std. Dev. Above Avg Reading Score
Panel A: Short-Term Academic Outcomes				
HS graduation	0.0665***	-0.00959*	-0.0264*	-0.0182*
	(0.0100)	(0.00531)	(0.0137)	(0.00967)
Enrollment two-year	0.0444***	0.00780	-0.00927	0.0445***
	(0.0125)	(0.00948)	(0.0195)	(0.0120)
Enrollment four-year	0.0324**	0.0415***	-0.0738***	0.0258*
	(0.0137)	(0.00923)	(0.0184)	(0.0144)
Enrollment two- or four-year	0.0766***	0.0432***	-0.0719***	0.0725***
	(0.0149)	(0.0104)	(0.0186)	(0.0109)
Panel B: Long-Term Academic Outcomes				
Credential two-year or Transfer	0.0696***	0.0283***	0.0119	0.0295***
	(0.0105)	(0.00749)	(0.0151)	(0.00991)
Graduate four-year	0.0134	0.0517***	-0.106***	0.0194
	(0.0134)	(0.00874)	(0.0196)	(0.0159)
Credential two- or four-year	0.0324**	0.0541***	-0.104***	0.0338**
	(0.0137)	(0.00884)	(0.0204)	(0.0161)

Table A.12. Heterogeneous Effects of DC for Students by Eligibility for Free/Reduced Price Lunch and Eighth-Grade Math Test Scores

	Ineligible for Free/Reduced Price Lunch		Eligible for Free/Reduced Price Lunch	
Variables	**Avg Eighth Grade Math Score**	**+1 Std. Dev. Above Avg Math Score**	**Avg Eighth Grade Math Score**	**+1 Std. Dev. Above Avg Math Score**
Panel A: Short-Term Academic Outcomes				
HS graduation	0.0469***	0.0108**	-0.0283**	-0.0176**
	(0.00884)	(0.00547)	(0.0132)	(0.00827)
Enrollment two-year	0.0458***	0.0121	-0.00583	0.0249**
	(0.0107)	(0.00836)	(0.0184)	(0.0103)
Enrollment four-year	0.0275**	0.0428***	-0.0694***	0.0125
	(0.0127)	(0.00917)	(0.0176)	(0.0119)
Enrollment two- or four-year	0.0721***	0.0500***	-0.0642***	0.0401***
	(0.0130)	(0.0101)	(0.0176)	(0.00972)
Panel B: Long-Term Academic Outcomes				
Credential two-year or Transfer	0.0650***	0.0363***	0.00969	0.0295***
	(0.00927)	(0.00670)	(0.0146)	(0.00971)
Graduate four-year	0.0279**	0.0395***	-0.0954***	-0.00694
	(0.0121)	(0.00839)	(0.0186)	(0.0136)
Credential two- or four-year	0.0435***	0.0454***	-0.0942***	0.00675
	(0.0123)	(0.00857)	(0.0193)	(0.0136)

Tables A.11 and A.12 show how the intersection of eligibility for free/reduced price lunch and test scores changes the effect of DC education. These results seem consistent with our previous results showing that students that are eligible for free/reduced price lunch have negative outcomes after taking DC education, and student with high eighth grade test scores see more gains from DC education. Interestingly though, students that are both eligible for free/reduced price lunch and have high test scores have significant and positive outcomes. In particular, students that are eligible for free/reduced price lunch and have average eighth grade reading scores are less likely to enroll in college by 7.2 percentage points after taking DC education, but the students with similar eligibility but with a one standard deviation above the mean in their eighth grade reading scores are 7.3 percentage points more likely to enroll in college after DC

education. We find a similar pattern with college completion. Free/reduced price lunch eligible students with average reading scores are 10 percentage points less likely to complete college, but students with similar eligibility but with a one standard deviation above the mean in their eighth grade reading scores are 3.4 percentage points more likely to complete college. We find a similar pattern based on eighth-grade mathematics scores.

When looking at students that are eligible for free/reduced price lunch, many of the outcomes are negatively affected by DC education as evidenced in Table A.8. However, once include interaction terms to account for differences in eighth grade test scores, we find that many of these significantly negative effects become no different from zero or in some cases positive for high-achieving students. This is not surprising given that Table A.9 demonstrates that students with higher eighth grade test scores have more positive effects from taking DC courses. Tables A.11 and A.12 demonstrate that when we simultaneously control for these two characteristics, we find that the positive effects from having a high eighth grade test score outweighs the negative effects from being eligible for free/reduced price lunch.

Racial Disparities Study: Methods and Results

In this section, we explain the methods and results for the analysis describing racial disparities in the DC participation. We used a regression analysis to determine how different factors contributed to racial disparities in DC participation. For the baseline, we regressed a student's race on DC participation and then added covariates one at a time to assess how specific covariates changed the participation rate.

Specifically, we ran this regression:

$$DC_{it} = \beta X_i + \tau_t + \varepsilon_{it}$$

DC_{it} is an indicator variable for if student i in cohort t participates in DC education, X_i is a vector of indicator variables for a student's race. τ_t is cohort fixed effects, which controls for any cohort specific confounders. Finally, ε_{it} is the error term. White is the omitted category to prevent collinearity.

Then we predict the values for participating in DC, which we call $\widehat{DC_{it}}$. This is done by taking the coefficients given by race (β) and rerunning the regression to retrieve the predicted values. We then plot those predicted values in the bar graph.

To see the effect of including different covariates, we add covariates one by one and then use them all together. Specifically we run this regression:

$$DC_{it} = \beta_1 X_i + \beta_2 Z_i + \tau_t + \varepsilon_{it}$$

The terms are the same as the previous regression except that Z_i represents a vector of covariates including DC and AP/IB availability at a student's high school, an indicator for if a student is eligible for free or reduced-priced lunch, and eighth-grade mathematics and reading test scores. We take the mean value for White students for each covariate in the regression and replace the values for that covariate for non-White students with the average White student score. We then predict $\widehat{DC_{it}}$ with the new values. This will give the average DC participation rate by race if non-White students had the same average value as White students. For example, we run this regression and use eighth-grade mathematics and reading test scores as a covariate, and we retrieve the effect of race and test scores on DC participation. We then give all non-White students the same average test scores as White students and then predict DC participation.

We also run a similar regression using high school fixed effects. Including this fixed effect will help control for time-invariant factors that are specific to certain high schools. Specifically, we run this regression.

$$DC_{it} = \beta_1 X_i + \mu_h + \tau_t + \varepsilon_{it}$$

The notation is the same as the previous regressions. μ_h is high school fixed effect. We predict $\widehat{DC_{it}}$ after running this regression as well. Finally, we estimate an equation with all of the covariates and fixed effects included. Specifically, we run this regression:

$$DC_{it} = \beta_1 X_i + \beta_2 Z_i + \mu_h + \tau_t + \varepsilon_{it}$$

The notation is the same as the previous regressions. We then predict $\widehat{DC_{it}}$ and plot the values for $\widehat{DC_{it}}$ by race for each of the regressions presented. This analysis gives a view into what observable characteristics account for different DC participation by race. For instance, we find that the gap between White and non-White student decrease after controlling for different eighth-grade test scores, which suggests that different underlying academic preparation is partially to blame for different DC participation rates by race. We present the regression results below:

Table A.13. Determinants for Racial Disparities of DC Participation by Race

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	**Took DC**	**Took DC**	**Took DC**	**Took DC**	**Took DC**	**Took DC**	**Took DC**
Asian	-0.0396***	0.00549	-0.0327***	-0.0651***	-0.0406***	-0.0370***	0.00003
	(0.00963)	(0.00684)	(0.0101)	(0.0104)	(0.00975)	(0.00962)	(0.00730)
Black	-0.139***	-0.112***	-0.115***	-0.0675***	-0.138***	-0.139***	-0.0310***
	(0.00539)	(0.00362)	(0.00483)	(0.00475)	(0.00538)	(0.00539)	(0.00253)
Hispanic	-0.0852***	-0.107***	-0.0528***	-0.0330***	-0.0852***	-0.0842***	-0.0442***
	(0.00637)	(0.00288)	(0.00567)	(0.00638)	(0.00630)	(0.00635)	(0.00207)
Other Race	-0.0571***	-0.0443***	-0.0483***	-0.0461***	-0.0570***	-0.0564***	-0.0251***
	(0.00374)	(0.00280)	(0.00362)	(0.00357)	(0.00372)	(0.00373)	(0.00250)
HS Offers AP/IB						-0.0559***	-0.0293***
						(0.0104)	(0.00622)
HS Offers DC					0.127***		0.0910***
					(0.00533)		(0.00686)
Math Z-Score				0.0761***			0.0782***
				(0.00218)			(0.00171)
Reading Z-Score				0.0485***			0.0467***
				(0.00110)			(0.00109)
Free/Reduced Price Lunch			-0.0648***				-0.0598***
			(0.00346)				(0.00174)
Junior Cohort Fixed Effects	X	X	X	X	X	X	X
High School Fixed Effects		X					X
Observations	3,504,227	3,504,136	3,504,227	3,504,227	3,504,227	3,504,227	3,504,136
R-squared	0.029	0.124	0.034	0.088	0.033	0.030	0.189

Appendix B. Advising Data Collection Instruments

THECB/AIR STUDY OF DUAL-CREDIT PROGRAM ADVISING PRE-INTERVIEW FORM

BACKGROUND

1. What is your official title? _____

2. What role do you play in advising dual-credit students? *(Select all that apply)*
   a. __ I directly advise dual-credit students
   b. __ I oversee high school guidance counselors or college advisors who offer dual-credit counseling
   c. __ I offer professional development and support to high school guidance counselors and college advisors who advise dual-credit students
   d. __ other: Please specify_____

3. What types of students do you advise?: (*Select all that apply*)
   __high school students who are enrolled in dual-credit courses at a traditional high school
   __high school students who are enrolled in dual-credit courses at an Early College High School
   __high school students who are not enrolled in dual-credit courses
   __college students
   __other: Please specify_____

4. Approximately how many students, including dual-credit students, overall do you currently advise? _____

5. Approximately what proportion of these students are enrolled in dual-credit courses? _____

6. For which program(s) does your institution offer dual-credit advising? *(Select all that apply)*
   a. ___academic programs
   b. ___career and technical education programs

7. For which grades do you provide dual-credit advising? (*Select all that apply*)
   __ 9th grade
   __ 10th grade
   __ 11th grade
   __ 12th grade

8. On average, how frequently do you hold an advising session with each dual-credit students you advise? *(Select one response)*
   __ weekly
   __ biweekly
   __ monthly
   __quarterly
   __ once during the semester
   __ never

9. On average, how many minutes do you spend advising dual-credit students in a single advising session? _____

10. Who initiates the majority of dual-credit advising sessions? *(Select one response)*
    __ high school students
    __ dual-credit advisors or counselors

11. What is the typical format of an advising session for dual-credit students? *(Select one response)*
    __one-on-one sessions
    __group meetings with all advisees
    __other: Please specify_____

12. Who leads these advising sessions? *(Select all that apply)*
    __high school guidance counselor
    __college advisor
    __high school teacher
    __college faculty
    __other: Please specify

13. How does your institution deliver advising to dual-credit students? (*Select all that apply*)
    __ face-to-face
    __ online
    __ a hybrid model that combines face-to-face and online modalities
    __ other: Please specify_____

14. What percent of your time do you dedicate to the following activities to provide guidance to dual-credit students? *[Please make sure that percentages add to 100]*
    __helping students select dual-credit courses
    __helping students develop time management and study skills
    __helping students navigate class schedules and registration waitlists
    __setting up student email accounts
    __providing emotional supports to students
    __helping students apply for financial aid
    __coordinating activities and meetings with dual-credit partners
    __other: Please specify:_____

AIR/THECB STUDY OF DUAL-CREDIT ADVISING IN TEXAS INTERVIEW PROTOCOL
Introductory Script [5 minutes]

[Note to Interviewer: Say additional words/phrases in brackets if group interview format used.]

Thank you for sharing your time with me today. My name is [insert name]. I am a researcher with Gibson Consulting, an education research firm. We have partnered with the American Institutes for Research (AIR), an independent non-profit research institute to conduct a study jointly funded by Educate Texas/ Communities Foundation of Texas, Greater Texas Foundation, Houston Endowment and the Meadows Foundation. This study is being conducted for the Texas Higher Education Coordinating Board (THECB) to learn about dual-credit advising policies and practices, and will not be used for compliance or accountability purposes. This study is an opportunity for stakeholders to share information about dual-credit advising policies and practices to identify best practices in dual-credit education.

[Today, we have assembled several of you from [insert institution name] in hopes that you could provide some insights on this topic.]

Your participation in this [group] interview is voluntary. You may choose not to participate in the interview, decline to answer any question, or stop the interview at any time without penalty. Our study team will keep what you say confidential. We will not be linking your responses with names or any other identifying information. This data will only be used by the research team at AIR/Gibson Consulting for the study, and we will not share your individual responses with THECB, the TEA, your [institution/school], the U.S. Department of Education, or anyone else outside of the research team. [However, because this is a group interview, please do not say anything you would not want others to know and talk about, as we cannot promise you that others on the line will keep what is discussed anonymous and confidential. We do ask that everyone on the line please respect the confidentiality of other participants and not repeat what we discuss outside of this interview.]

FOR COLLEGE ADVISORS ONLY

Your institution may have established a dual-credit partnership with more than one high school. If this is the case and your advising role and/or activities differ across the partnering high schools with which you work, we ask that you respond with [NAME OF PARTNERSHIP] in mind.

I estimate our conversation today will last about 60 minutes. [Because this is a group interview conducted by phone, speak clearly and one at a time so that we can hear everyone.] I will be jotting some notes so I can remember what you say. In addition, I would like to audio-record today's discussion to check the accuracy of my notes. The notes and the audio-recordings will be destroyed as soon as the research team has completed data collection and analysis. Is this alright with you? Do you have any questions for me at this point before we begin?

I. Context [Approximate length of time: 5 minutes]

1. GQ: For my notes, please state your name, title, and role in overseeing or providing dual-credit advising services.

2. SQ: For your particular partnership with [INSTITUTION/HIGH SCHOOL], can you describe what dual-credit advising looks like from the start to the end of the academic year, and anything that may occur after a student completes a dual-credit course?

3. SQ: To what extent are [high school guidance counselors/college advisors] involved in decisions around dual-credit advising? What roles do they take on?

For high school counselors who report providing guidance to dual-credit students and non-dual-credit students, ask:

4. SQ: How does advising for dual-credit students at [HIGH SCHOOL] differ from guidance you provide to students enrolled in A.P. or I.B. courses? And to students who are not enrolled in any courses that may lead to college credit?

For college advisors who report providing guidance to dual-credit and college credit-only students, ask:

5. SQ: How does advising for dual-credit students at [HIGH SCHOOL] differ from guidance you provide to students enrolled in college credit-only courses?

Listen for:

- Degree versus non-degree seeking
- Undeclared field of study or major

II. Selection into Dual-Credit Education: [Approximate length of time: 20 minutes]

The next set of questions are about how you help select students for dual-credit education.

6. SQ: For your partnership with [INSTITUTION/HIGH SCHOOL], are you involved in the process of selecting students for dual-credit education?
   - *For college advisors,* Is this also the case for your partnership with your [institution's] other high school partners?

SKIP LOGIC: If yes to Question 6, answer the following questions:

7. SQ: Are certain types of students encouraged to consider enrolling in dual-credit education? If yes, what are the characteristics of those students?

For high school counselors who report providing guidance to dual-credit students and nondual-credit students, ask:

8. SQ: How are the students who are encouraged to enroll in dual-credit education different from the students who are encouraged to take A.P. or I.B. courses?

9. SQ: From your perspective are there any factors at [HIGH SCHOOL] that challenge or limit certain groups of students' access to or ability to enroll in dual-credit courses through this partnership?

10. SQ: Are there certain types of students at [HIGH SCHOOL] that you think should be advised against taking dual-credit courses? Why?

II. Course Selection [Approximate length of time: 20 minutes]

I want to continue by asking a number of questions about how you help students choose dual-credit courses.

11. SQ: For your partnership with [INSTITUTION/HIGH SCHOOL], are you involved in the process of helping students choose which dual-credit courses to take?
    - *For college advisors,* Is this also the case for your partnership with your [institution's] other high school partners?

SKIP LOGIC: If yes to Question 11, answer the following questions:

12. SQ: In your partnership with [INSTITUTION/HIGH SCHOOL], what specific factors do you consider when counseling students into academic dual-credit courses?
    [Ask ALL following probes]
    - How does a students' anticipated major, field of study, or career trajectory play a role in the advising students receive about which dual-credit courses to take?
    - How does the student's grade level play a role in the advising students receive about which dual-credit courses to take?
    - Finally, how do non-cognitive characteristics, such as motivation or emotional maturity, play in advising dual-credit students around course-taking?

13. SQ: In addition to these factors, do you also consider credit-transfer policies and review these policies with students?
    - If yes, what is your source of information for credit-transfer policies? Are these policies clear to you?
    - If no, can you explain why credit transfer is not a factor you consider in counseling students on which dual-credit courses to choose?
    - To what extent do you feel more guidance to counselors/advisors on credit transfer policies for this partnership with [INSTITUTION/HIGH SCHOOL] would be helpful?

14. SQ: How much latitude do students have over selecting which and how many dual-credit courses to take at [HIGH SCHOOL]?

15. SQ: Are students at [HIGH SCHOOL] required to design a program of study to help them map the courses they need to take to earn their desired degree? What does that program of study look like?

Ask only those who reported in the intake form that their institution delivers both academic and CTE dual-credit advising.

16. SQ: To what extent is advising students into CTE dual-credit courses different from advising into academic dual-credit courses? How?

II. Information Sharing [Approximate length of time: 10 minutes]

Now I'd like to learn from you about the sorts of information and materials dual-credit students receive, and is shared between your institution and your dual-credit partner.

17. SQ: What kinds of information/materials do you provide to dual-credit students at [HIGH SCHOOL]?

Listen for:

- Tuition and fees
- Financial aid
- Course catalogs and schedules
- Course sequences
- Course registration processes and procedures
- New student orientation resources (getting school ID care/use of library)
- Online sources of information/tools
- Key contacts at the college
- Credit transfer
- Career planning
- Student support services
- Choosing an academic field of study or a major

18. SQ: How is this information shared with dual-credit students at [HIGH SCHOOL]? [PROBE: electronically, face-to-face, mail]

Ask the next question of college advisors only:

19. SQ: How, if at all, does the information/materials for new college students differ from the information/materials provided to dual-credit students at [HIGH SCHOOL]?

20. SQ: What information do you share with your dual-credit education partner? What information do they share with you?

IV. Coordination with Dual-Credit Partners [Approximate length of time: 15 minutes]

Next, I'd like to hear from you about how you work with your counterparts to deliver dual-credit advising.

21. SQ: How would you describe the level of coordination you have with your [institution/high school] partner with respect to your advising responsibilities? Please elaborate on how you coordinate activities related to dual-credit advising.

22. SQ: Do you think greater coordination of information and/or activities between your [school/institution] and your dual-credit partner(s) is needed? What would you change if you could?

23. SQ: Have you received any training specific to advising dual-credit students with respect to this dual-credit partner specifically? If yes, please describe.

V. Challenges of Advising Dual-Credit Students [Approximate length of time: 5 minutes]

Thank you for your answers thus far. Now, I would like to get your thoughts about the challenges of delivering dual-credit advising.

24. GQ: What are the main challenges you encounter in advising dual-credit students generally? Are there any challenges specific to the partnership you have with [institution/HIGH SCHOOL]?

Listen for:

- Challenges related to pressure to counsel students into dual-credit education and specific dual-credit courses that are relevant to their future degree or career plans
- Challenges related to working with/getting information from/coordinating with your dual-credit partner
- Challenges related to lack of or inconsistent guidance on how to advise students
- Challenges related to how to determine which students are most likely to be successful in dual-credit education
- Challenges related with working with high school students and their parents

25. GQ: Thinking generally, what supports or improvements to the advising process would help you overcome these challenges? What might help students become more strategic when choosing courses so they count towards their major or field of study?

VII. Wrap up

26. GQ: Is there anything else you'd like to share about your experiences as a dual-credit advisor, or the advising process that we haven't already discussed either generally or with the dual-credit partner we asked specific questions about today?

Thank you for your time and participation in this interview!

Appendix C. Advising Interview Sample

Our final interview sample included counselors and advisors from 50 high schools and 52 IHEs. To recruit our interviewees, we sent an email to the individual at each of our sampled institutions that oversaw and managed DC education at high schools. We asked them to identify individual(s) at their college and their high school partner we were targeting for our study who were involved in student advising and could answer questions about how students were counseled into DC programs and courses. Through this process we completed a total of 102 interviews, including 52 with college advisors (45 2-year college advisors and seven 4-year college advisors) and with 50 high school counselors. Table C1. provides the number and type of respondents that were interviewed by the key features of how their institutions and high schools and how they delivered DC education.

Table C1. IHE and High School Characteristics of the Interview Sample

Characteristics of DC Delivery in Sampled Institutions		Interviews	Interviews by Interviewee Type	
Overall		102	2-year college advisors	45
			4-year college advisors	7
			High school guidance counselors	50
Urbanity	Rural high schools ≥ 75%	45	2-year college advisors	18
			4-year college advisors	5
			High school guidance counselors	22
	Urban high schools < 75%	57	2-year college advisors	27
			4-year college advisors	2
			High school guidance counselors	28
ECHS	ECHS partner	25	2-year college advisors	8
			4-year college advisors	3
			High school guidance counselors	14
	No ECHS partner	77	2-year college advisors	37
			4-year college advisors	4
			High school guidance counselors	36

Characteristics of DC Delivery in Sampled Institutions		Interviews	Interviews by Interviewee Type	
CTE	CTE ≥ 75%	4	2-year college advisors	2
			4-year college advisors	0
			High school guidance counselors	2
	CTE < 75%	98	2-year college advisors	43
			4-year college advisors	7
			High school guidance counselors	48
Online	Online/hybrid ≥ 50%	13	2-year college advisors	7
			4-year college advisors	1
			High school guidance counselors	5
	Online/hybrid < 50%	89	2-year college advisors	38
			4-year college advisors	6
			High school guidance counselors	45
Student demographics	Minority	43	2-year college advisors	17
			4-year college advisors	4
			High school guidance counselors	22
	Non-minority	59	2-year college advisors	28
			4-year college advisors	3
			High school guidance counselors	28
	Low-income	100	2-year college advisors	45
			4-year college advisors	6
			High school guidance counselors	49
	Not low-income	2	2-year college advisors	0
			4-year college advisors	1
			High school guidance counselors	1
Region	West Texas/Panhandle	18	2-year college advisors	7
			4-year college advisors	0
			High school guidance counselors	11
	Central Texas	10	2-year college advisors	7

Characteristics of DC Delivery in Sampled Institutions		Interviews	Interviews by Interviewee Type	
			4-year college advisors	0
			High school guidance counselors	3
	Houston/Gulf Coast	26	2-year college advisors	12
			4-year college advisors	2
			High school guidance counselors	12
	Dallas/North Texas	16	2-year college advisors	7
			4-year college advisors	0
			High school guidance counselors	9
	South Texas	11	2-year college advisors	4
			4-year college advisors	3
			High school guidance counselors	4
	East Texas	21	2-year college advisors	8
			4-year college advisors	2
			High school guidance counselors	11

Appendix D. Advising Interview Codebook

AIR/THECB STUDY OF DUAL-CREDIT INTERVIEW CODEBOOK

Construct/ "Code name"	Subconstruct/ "Subcode name"	Protocol Question #	Pre-interview Form Question #	Code definition
Construct 1: Advisor/ counselor roles and responsibilities/ "Roles and responsibilities"		1, 3, 6, 11	1, 2, 14	Role of counselor/advisor in advising DC students, including whether counselor/advisor is involved in selecting students for DC and/or involved in helping students choose which courses to take; also includes time spent on specific topics/activities (e.g., DC course selection, time management and study skills, class schedules/registration, email account set up, emotional support, financial aid, etc.); Also include responses that speak to the role of their HS/IHE counselor/advisor counterpart at their partner school/institution
Construct 2: How DC advising differs from other student advising/ "Distinctness of DC advising"		4, 5, 16, 19		How/to what extent advising for DC students differs from advising for AP, IB, and CTE students, or students not enrolled in college-going courses; as well as from advising for students enrolled in college credit-only courses
Construct 3: Targeted students "Targeted students"		2, 6, 7, 8, 9, 10	3, 4, 5, 7, 8, 9, 10	The types and grade levels of students advised, how students are selected for DC, and how many students are enrolled in DC courses; as well as what types of students/what are the characteristics of students encouraged to enroll in DC; includes perceptions about whether students are being incorrectly advised into/out of DC

Construct/ "Code name"	Subconstruct/ "Subcode name"	Protocol Question #	Pre-interview Form Question #	Code definition
Construct 4: Format of advising sessions/ "Advising format"		2, 3, 17, 18	8, 9, 10, 11, 12	How frequently and for how long counselors/ advisors meet with students; how advising sessions are initiated; the format of the advising sessions, including who leads them, mode of delivery
Construct 5: Relationship/coordination between HS partner and college partner/ "DC partner coordination"	Construct 5.1: Information shared between partners/ "Information shared"	13, 20, 21, 22		Level of coordination between high school and college partner, including how high school guidance counselors work with college advisors. Also includes perceptions of whether greater coordination is needed. For 5.1: Information shared between the partners (including information about credit transfer policies); also includes perceptions of whether more/different types of information shared is needed or if support is sufficient.
Construct 6: Kinds of information shared with students/ "Information shared with students"	Construct 6.1: How information is shared with students/ "How information shared"	17, 18		The kinds of information dual-credit advisors or counselors share with students and parents/families (e.g., tuition and fees, financial aid, course catalog, key college contacts, online resources, etc.); also includes whether the types of information for DC students differs than for college credit-only students. Include responses about recruitment materials/ advertising produced to let students and families/ parents know about DC opportunities. For 6.1: How information is shared (e.g., electronically, face-to-face, etc.); also includes

Construct/ "Code name"	Subconstruct/ "Subcode name"	Protocol Question #	Pre-interview Form Question #	Code definition
				whether how information is shared with DC students differs than for college credit-only students
Construct 7: Factors counselors/ advisors consider in advising DC students "Advising considerations"		2, 3, 12, 13		The procedures and guidelines (including any testing requirements/ established criteria) the institution has established for advising practices and student eligibility for DC, including how counselors and advisors consider a student's academic and behavioral preparation, credit-transfer options, as well as a student's major and/or career plans
Construct 8: Students' roles in selecting DC courses/ "Student autonomy"		14, 15		Includes extent to which students have autonomy in selecting DC students and any requirements for DC students (e.g., completing a program of study to map out course taking).
Construct 9: Supports/trainings provided to counselors/advisors/ Advisor training"		4, 23		Includes training on DC education generally, on how to advise students, and trainings specific to working with the partner of interest for this study.
Construct 10: Challenges/ "Challenges"		24		The challenges that dual-credit advisors or counselors encounter when advising dual-credit students, including challenges related to working with DC partner.

Construct/ "Code name"	Subconstruct/ "Subcode name"	Protocol Question #	Pre-interview Form Question #	Code definition
Construct 11: Supports needed to improve DC advising/ "Supports needed"		25		Any supports that advisors or counselors indicate are needed to improve the advising process for DC students. Include also any recommendations to improve the advising process, even if specific supports aren't mentioned. Also include any responses that indicate what might help students be more strategic in making DC course choices.
Construct 12: Notable practices				Double code any responses that indicate a certain practice/activity was reported as particularly beneficial or effective related to the advising process
Construct 12: General Comments		26		Include responses here that don't neatly fit into other constructs/codes and we can figure out which other constructs additional comments may apply to.

Appendix E. Detailed Cost Descriptions for Traditional Dual-Credit Models by Community College

Costs for Community College A and Its District Partners

Community College A is a large community college serving an urban area with nine traditional school districts and five charter school districts. Over the past decade, the college has actively pursued certification of high school teachers to serve as dual-credit instructors. As a result, the majority of DC courses in Community College A are taught by high school teachers, rather than community college faculty. We conducted interviews with staff members at multiple departments at the community college central office and at the three largest school districts in the area, which collectively account for approximately three-quarters of all DC in the region.

Table E.1 shows the annual cost per SCH across these three districts for DC coursework that takes place in traditional, non-ECHS. The per-SCH cost in Districts 1A, 2A, and 3A is $127, $111, and $121, respectively. In general, the cost burden of dual credit is approximately equal between the community college and school districts, with students bearing a very minor proportion of costs. Differences in the cost across districts (and the cost burdens) result from differences in school district central office staffing patterns and differences in who teaches dual-credit courses in each district, on average (full-time community college faculty, part-time community college faculty, or high school teachers). In the sub-sections below, we describe the resources that generate these costs. We discuss, in turn, the community college central office costs, school district administrative and advising costs, instructional costs for the community college and school districts, and finally, all other costs associated with dual credit. We then briefly describe how costs are distributed across stakeholders.

Community College Administrative and Advising Costs for Community College A

Community College A has a robust central office staffing model for DC. The College employs a Dean of DC, who has two full-time administrative assistants. Two faculty members provide additional assistance, allocating 20% of their time through a course-release of one course per semester. Among other DC-related tasks, these individuals provide professional development to new dual-credit teachers. An office of student services includes an associate director of DC and two administrative assistants (one full-time and one part-time). A total of five administrative and registrar specialists are assigned to dual credit. The counseling department includes a counseling coordinator for DC, a districtwide academic counselor for DC, and an academic counselor specialist for DC, each of whom allocate all of their time to DC-related

efforts. These individuals are compensated based on the full-time community college faculty salary schedule.

The Office of Instructional Deans includes a total of twelve subject-specific instructional deans across various community college campuses. These individuals approve courses for a subset of subject areas. The time allocation for these 12 deans is approximately commensurate with proportion of DC and non-DC courses at the college. Community College A also employs faculty coordinators, who are responsible for recommending course approval to subject-specific instructional deans (for both DC and traditional community college courses), evaluating other community college faculty and high school teachers assigned to DC, and evaluating labs and other physical DC classroom space on high school campuses. Faculty coordinators are full time community college faculty and typically oversee 15 courses or 45 SCH. These individuals receive one course release for each 45 credits they are assigned. The last personnel category in the Office of Instructional Deans is faculty liaisons who serve as liaisons for each high school principal and community college staff. There is a total of five faculty liaisons, each of whom are full time community college faculty who receive one course release for their services.

Other community college personnel at the central office include staff members from the Library Services, Center for Students with Disabilities, Center for Distance Learning, Institutional Research, Testing Center, Information Technology, and Office of Student ID Card. Staff members from each of these offices reported allocating between 5%-10% of their time to DC. As shown in Table E.1, the annual cost per SCH of central office staffing for Community College A is $51.20. Community college central office costs per SCH are the same across districts because we prorate costs across districts based on the number of SCH. One-third of those costs result from the salaried work time of faculty coordinators, 15% come from the administrative and registrar specialists, another 15% is generated through the Dean of DC and members of the Dean's staff, and the rest of the community college central office costs (approximately 40%) is generated through all other staff members listed above.

School District Central Office and Site-Based Administrative and Advising Costs for District Partners of Community College A

The three districts we sampled have similar central office staffing patterns for administering DC. Each school district employs a DC liaison, who facilitates communication between the Dean of DC and the district central offices. In District 1A, this person allocates half their salaried work time to DC, whereas the DC liaison allocates 30% and 70% of their time in Districts 2A and 3A, respectively. In District 1A, the Executive Director of curriculum and Instruction allocates 10% of

their time to support DC teacher certification and monitor DC course scheduling, whereas the executive director of High School Academics takes on a similar role in District 2A. The associate Superintendent for High Schools in Actively involved in DC in Districts 2A and 3A, but no in District 1A. District 1A has the highest administrative costs largely because four district-level counselors in the central office, who supervise site-based counselors, allocate 20% of their time each to DC education. Other staff members who allocate some time to DC education at the central office level include the textbook warehouse service coordinator, the Director of Language Proficiency Assessment Committee, and Texas Success Initiative (TSI) proctors and TSI "bootcamp" teachers. Under Texas Education Code, students must be identified as "college ready" prior to enrolling in college-level coursework including dual credit. Students gain this designation by passing TSI assessments or through waivers granted to students who pass Advanced Placement courses or who earn high scores on the SAT, ACT. The responsibility of meeting TSI requirements falls on the student, but postsecondary institutions typically assist students with the process. Community College A worked help certify district officials so that students can complete TSI assessments on high school campuses. As a result, districts offering dual-credit education incur costs for TSI testing, which include salaried work time for test proctors, a week-long half-day test preparation session (the TSI bootcamp, held in all three districts), and TSI testing units, which we discuss below.

School-level costs for DC include salaried work time for assistant principals and counselors. Principal and assistant principal DC liaisons in Districts 1A and 2A estimated that at each high school one academic counselor allocates approximately 0.10 FTE (about four hours per week) for activities related to DC that they would otherwise allocate to other matters in the absence of DC. Counselors in District 3A spent slightly less time (about 0.05 FTE). In exchange, these counselors oversee a smaller number of students than other academic counselors in the building (i.e., receive a "smaller alpha"). Similarly, across all three districts, one assistant principal is selected to oversee DC, representing approximately 0.10 FTE of their typical work week. Finally, the school district provides their own specialized professional development for new dual-credit teachers.

Instructional Personnel Costs for Community College A and Its District Partners

Over that past 10 years, Community College A has partnered with the local 4-year university to certify a substantial number of high school teachers to serve as DC instructors. According to Texas Education Code, to teach a DC course, high school teachers must have a Master's degree and 15 credit hours in the subject area in which they will receive certification to teach DC courses. To increase the number of teachers with DC certifications, the community college re-

directed external, philanthropic donations from student scholarships for DC to scholarships for high school teachers. As a result of these efforts, high school teachers instruct most DC courses at Community College A. As shown in Table E.1, the community college incurs instructional costs of $11, $9, and $15 per SCH in Districts 1A, 2A, and 3A, respectively. Most faculty at Community College A are full-time, which generally increases costs; however, because the majority of SCH are granted in courses taught by high school teachers, instructional costs for Community College A are generally lower than in other community colleges in our sample.

Offering DC courses on a high school campus, taught by high school teachers, does not increase teacher staffing costs for schools because DC courses count as regular high school courses (and would exist in the absence of DC). In contrast, the school district can reduce teacher staffing levels when dual-credit courses are taught by community college faculty, rather than high school teachers. While the majority of DC at Community College A is taught by high school teachers, DC liaisons and district administrators noted the cost savings associated with assigning community college faculty as instructors of dual-credit courses. As one district administrator reported, "If dual credit were to go away, then we would have to absorb those kids back into our system and it would cost us a lot of money to do that. That instruction right now, we would have to instruct those classes because [students] are counting on almost all of them for graduation requirements." We account for reduced teacher staffing costs based on the number of SCH taught by a community college faculty member, assuming each DC course taught by a community college faculty member is a DC course that does not need to be taught by a high school teacher. Our data show that the average high school teacher course load is five courses per semester (10 per year), the average class size is 24 students. Thus, the school district can reduce one FTE teacher for each 720 SCH (3 SCH per student per course x 24 students per course x 10 courses per year). As shown in Table E.1 the average cost savings for reduced teacher staffing in Districts 1A, 2A, and 3A are $7, $10, and $9, respectively.

Other Costs for District Partners of Community College A and Its Students

In addition to personnel costs, stakeholders incur non-personnel costs for textbooks, high school teacher stipends, transportation, and TSI testing units. In all three districts, textbooks are provided to students for who enroll in DC courses. Textbook for courses taught by community college faculty are based on a one-semester cycle, whereas those taught by high school teacher are typically replaced every four years (a requirement in each of the MOUs). We calculate the costs of textbooks over and above the cost of textbook in traditional non-DC courses, in which most textbooks run on a 10-year cycle. Stipends for teacher who teach dual credit ranged from $100 to $600 per course.

School districts provide transportation for students from their local high school to a community college campus. District officials reported that only about one-third of students use the transportation (the other one-third provide their own transportation). We drew on publically available TEA data to determine that the average per-student expenditures on transportation for the three largest district in the region is $244, or $81 per student if one third of students use the service. This estimate is close to one district official's estimate that the transportation costs associated with 300 students enrolling in DC on a community college campus would typically costs the district $25,000 or $83 per student.

Students also incur a small amount of costs related to transportation to community college campuses. Because textbooks and tuition fees are all paid for by the school district, the only cost is transportation to community colleges, for those students who choose not to use the district-provided transportation. District officials estimated that approximately two-third of students provide their own transportation and the typical student travels five miles two per week to attend two courses on a community college campus.

School district incur the costs of credential teachers (although much of these costs are defrayed through external funding provided through philanthropic donations). To be certified to teach DC, high school teachers must have a master's degree including 15 SCH in the content area. Nearly 100 teachers in District 1A currently hold credentials to teach dual credit. Half of these individuals already held an MA degree, while the other half completed their degree at the local university to obtain DC certification. We estimate the cost of completing an MA degree, based on the cost of tuition and books, approximately $8,000 (these figures are rounded to maintain anonymity). Given the average tenure of teachers in the area is about 11 years, we annualize these costs over 11 years using a discount rate of 5%. The resulting cost is $1,402 per teacher per year for each credentialed teacher.

The final two non-personnel costs that school districts incur are related to the Texas School Initiative. The district's TSI "bootcamp" includes various materials that amount to approximately $20 per participant. In addition, districts pay a fee per unit of $1.70 for TSI testing credits. Districts purchase one credit for each student in each subject for a pre-test and three credits for each test. On average, each dual-credit student requires approximately 7.5 units to become eligible for DC in two subjects.

Tuition and Fees

Community College A charges school districts $100 per student per dual-credit course when the course is taught by a community college faculty member. Tuition is waived for courses taught

by high school teachers and for courses taken by early college high school students. As shown in Table E.1, tuition payments do not affect the total cost per SCH, but they decrease the cost burden the community college and increase the cost burden to the school district. However, because high school teachers are the instructors for the vast majority of DC courses in Community College A, the total tuition payments per SCH are generally low.

Table E.1. Costs per semester credit hour for three school districts partnering with Community College A

Cost Category	District 1A		District 2A		District 3A	
College Admin. and Advising	$51.20		$51.20		$51.20	
College Instructional Personnel	$10.53		$9.49		$14.71	
District and High School Admin and Advising	$43.22		$34.00		$38.49	
High School Teacher Cost Savings	(6.55)		(10.48)		(8.76)	
District and High School Other Costs	$27.98		$26.32		$24.45	
Costs to Students	$0.59		$0.33		$0.97	
College Cost Pre-Tuition	$61.73	48.6%	$60.69	54.7%	$65.91	54.4%
School District Cost Pre-Tuition	$64.65	50.9%	$49.84	45.0%	$54.18	44.8%
Student Cost Pre-Tuition	$0.59	0.5%	$0.33	0.3%	$0.97	0.8%
College Tuition (Revenue)	(4.31)		(2.92)		(6.07)	
District/HS Tuition	$4.31		$2.92		$6.07	
Students Tuition	$0.00		$0.00		$0.00	
College Cost Post-Tuition	$57.42	45.2%	$57.77	52.1%	$59.84	49.4%
School District Cost Post-Tuition	$65.47	51.6%	$60.60	54.7%	$51.62	42.6%
Student Cost Post-Tuition	$0.59	0.5%	$0.33	0.3%	$0.97	0.8%
Total Cost	$126.98		$110.86		$121.06	

Costs for Community College B and Its District Partners

Community College B is located in an urban metropolitan area and enrolls over 20,000 students with approximately one-quarter enrolled as high school students through dual credit. The College partners with over 25 districts to offer dual-credit education courses. Community College B uses adjunct faculty for about two-thirds of all courses, and adjunct faculty are disproportionately assigned to dual-credit courses (teaching approximately three-quarters of all dual-credit courses). In the sub-section below on instructional costs, we describe how this unique arrangement influences costs.

As shown in Table E.2, the annual cost of dual-credit education for dual credit administered in comprehensive high schools through Community College B is $88 per-semester credit hour in one sampled district and $66 in a second district, with the majority of the cost burden falling on the community college. In the sub-sections below, we describe the resources that generate these costs. As before, we first describe the community college central office costs, and then describe school district administrative and advising costs, instructional costs for the community college and school districts, and finally, all other costs associated with dual credit. We then briefly describe how costs are distributed across stakeholders.

Community College Administrative and Advising Costs for Community College B

The central office administration in Community College B includes three separate offices that together are responsible for administering dual credit: (a) a high school relations office that works with area school districts; (b) an office of academic advising; and (c) an office of student services (to maintain anonymity, we do not use the official office names). The high school relations office includes an executive director, a full time administrative assistant, two data entry administrators, and two coordinators. The office of academic advising includes an executive director and an administrative assistant, and a total of four full-time advisors and two advisor managers, all of whom are assigned 100% to dual credit. An office of student services (enrollment) includes an executive director, a full time administrative assistant, two enrollment managers, and seven enrollment coordinators.

A number of other staff members in various offices in Community College B allocate a portion of time to dual credit. Librarians work with dual-credit students, particularly on Fridays, when high school students are assigned to a community college campus, but are not in class (since most classes meet either Mondays and Wednesdays or Tuesdays and Thursday). The executive director of dual credit in the high school relations office estimated that two librarians spend approximately two hours per week to oversee dual-credit students, amounting to a total of 4 hours per week or 0.10 full-time equivalent (FTE) librarians across all community college campuses. Community college administrators estimated that three IT specialists allocated approximately one-third of their time each to assisting dual-credit students. An additional staff member who oversees student ID cards allocates approximately one-quarter of their time to dual-credit students. Finally, dual credit creates the need for additional faculty evaluation. Faculty evaluation in smaller departments is generally part of the daily work schedule of department chairs (and represents only a small proportion of their time); however, larger departments form faculty evaluation committees and the chair of those committee receives one course release per semester. Community college administrators estimated that a total of

16 departments have faculty evaluation committees, resulting in a total of 3.2 FTE community college faculty members, given a teaching load of five courses per semester (16/5 = 3.2).

Administration of dual credit at the community college central office also involves non-personnel costs including a customer relationship management (CRM) enrollment system the community college purchased to help administer dual credit (a total cost of $40,000 per year or about $0.67 per semester credit hour), reimbursement for community college faculty travel to local high schools, and stipends to community college faculty for serving as mentors of new dual-credit teachers ($400 per mentor). While we report findings based on the annual cost per semester credit hour, we can also determine the total, per-student, and per-semester credit hour costs at each high school, to gain a sense of the cost impact for an individual school or district. To determine the costs for each high school (or district), we prorate community college central office and advising costs across all schools with which Community College B partners, based on the number of semester credit hours at each school. In total, the annual administrative and advising cost for Community College B is $1.9 million or about $32 per SCH. Table E.2 below shows the annual cost per semester credit hour of dual credit in comprehensive high schools (we discuss the cost of dual credit in early colleges in a separate section). As shown in Table E.2, this cost is the same across districts.

School District Central Office and Site-Based Administrative and Advising Costs for District Partners of Community College B

The districts we sampled for Community College B are two of the area's largest in terms of both total enrollment and the total semester credit hours received, collectively accounting for about one-third of all dual-credit semester credit hours granted per year through Community College B. These two districts take somewhat different approaches to offering dual credit. District 1B has prioritized dual credit as a major initiative and has opened high school programs that specialize in dual-credit delivery, such as early colleges, in half of the district's high schools. The director of the college readiness office reported spending approximately half her salaried work time on dual-credit education and estimated that the associate superintendent for high schools allocated about one-quarter FTE. The district also has a director of early colleges who allocates 0.45 FTE to dual credit (their time is often pulled to other nondual-credit tasks). Central office personnel also include the district registrar (10% FTE) and Texas School Initiative (TSI) assessment proctors, who are either paraprofessionals assigned to proctor TSI assessments or are external members hired on an hourly basis. At District 1B high schools, Principals and the academic dean both allocate time to dual credit. The district uses non-certificated college advisors to provide academic advising to dual-credit students (allocated at 0.50 FTE for each

1,000 semester credit hours). These individuals also help promote FAFSA completion and college applications. The presence of college advisors allows the Academic Counselors to focus on ensuring students have the necessary requirements to finish high school. The district uses the school-within-school early college model and has early college coordinators at each early college high school, but those individuals are responsible for a wide number of tasks, such as creating the master schedule, overseeing FAFSA applications, and other tasks not directly tied to dual credit in particular (i.e., activities that would exist in the absence of dual credit). Early college coordinators therefore allocate roughly 0.45 FTE to dual credit. The district also hires substitutes or specifically allocates teachers to meet with dual-credit students on Friday afternoons, when students are enrolled in dual-credit courses that meet only Mondays through Thursdays, but the district would otherwise be responsible for students during this time anyway and so substitutes and special teacher scheduling does not generate additional costs. In total, the costs of school district administration and advising in District 1B is about $60 per semester credit hour as shown in row 3 of Table E.2

District 2B has a leaner dual-credit administrative structure, despite the fact that the district's annual number of semester credit hours is almost has high as District 1B. As shown in in row 3 of Table E.2, the per-semester credit hour cost of district administration and advising District 2B is $31. The district has only two individuals in the central office who allocate more than a trivial amount of salaried work time to dual credit (a senior director of college readiness who serves as the liaison between the district and community college, and a dual-credit coordinator). District 2B also has TSI proctors assigned to multiple schools and we used the same formula to determine the total FTE for TSI proctors (6 total hours for each 24 students who initially enrolls in dual credit each year). At the school-level, academic counselors focus primarily on high school completion and college readiness, while allocating only a small proportion of time to dual-credit advising. Instead, the district hires dual-credit coordinators at each high school who allocate approximately 75% of their time to dual credit.

Instructional Personnel Costs for Community College B and Its District Partners

In all districts partnering with Community College B, data show that the majority of dual-credit courses are taught on a high school campus by adjunct community college faculty. While most adjunct faculty teaching in high schools are employed primarily by the community college, a small proportion are actually high school teachers. In contrast to other dual-credit delivery models, high school teachers who teach dual credit go through the same interview process as other adjunct faculty members and become formal employees of the community college. These individuals receive compensation both as adjunct faculty and as K–12 teachers (they are reported as K–12

teachers in our data; however, community college administrators reported that all high school teachers who teach dual credit in the area are required to become adjunct community college faculty). In District 1B, dual-credit teachers (who are also employed as adjunct community college faculty) also receive a stipend of $1,000 (included as "other costs" below).

Because Community College B uses similar delivery mechanisms with each partnering district (relying primarily on adjunct faculty traveling to high schools, with additional courses offered on the community college campus), the cost of instructional personnel is similar across districts, $43 and $41 in District 1B and 2B, respectively, as reported in row 2 of Table E.2. The slight difference results from the specific number of full-time versus part-time community college faculty teaching courses in each district and the amount of travel reimbursement (Community College B reimburses faculty for travel to area high schools). These cost figures include instructional costs for the community college for course taught on both high school and college campuses, by both adjunct and full-time faculty, and both online and face-to-face. Online courses have similar cost implications except the community college does not need to reimburse faculty for travel, students and school districts do not incur transportation costs, and districts need to assign a staff member to a classroom for online coursework that takes place during the fall or spring semester. Interestingly, because of the low wages adjunct community college faculty receive, dual-credit courses taught by adjunct faculty in high schools – the primary delivery mechanism at Community College B – is the least expensive method. Although some dual-credit courses are taught by adjunct faculty who are also full-time high school teachers employed by the district who (in District 1B) receive stipends in addition to their annual salary, that mechanism is generally less common in Community College B and as a result, the annual cost per semester credit hour in Community College B is generally lower than in other sites that we sampled.

Both school districts save a significant amount of money through reduced teacher staffing associated with dual credit. As noted above, whether students leave campus to attend dual-credit courses, or community college faculty come to the high school, district administrators reported significant savings associated with reduced teacher staffing. Districts do not lose state funding as long as they are present for four hours during the day (or meet other requirements, see Texas Education Agency, 2017) and districts administrators schedule dual credit to meet this minimum attendance requirement. We account for this savings using similar methods as described earlier. As shown in Table E.2, District 1B receives an average of $80 per semester credit hour in cost-savings, while District 2B receives $77 per semester credit hour. The difference in cost-savings results from the fact that districts do not save money when high school teachers teach dual-credit courses, which we can observe for each individual high school in our data.

Other Costs for District Partners of Community College B and its Students

Other costs for school districts and students include textbooks, transportation, and TSI testing units. District 1B pays for textbooks for students in early colleges, and splits the cost of textbooks with students in dual-credit courses outside of early colleges. District administrators estimated that courses taught by community college faculty require students to purchase a textbook for each course, while textbooks run on a four-year cycle for dual-credit courses led by high school teachers. The typical high school class textbook runs on a 10-year cycle, so the costs of textbooks for dual credit is based on the additional costs associated with shorter cycles. District 1B also encourages students to share textbooks or makes copies in some cases, reducing the overall cost of textbook by an estimated 25%. In District 2B, students pay for all of the costs of textbooks regardless of setting. Depending on the context and course delivery mechanisms, textbooks represent between 10-15% of the total annual cost of dual-credit education at Community College B.

Transportation in District 1B is provided to early college students free of charge. District officials estimated that about one-third of students use this transportation, whereas students provide their own transportation in all non-early college dual-credit courses in both districts. In general, transportation represents a small proportion of the overall costs. Finally, both districts pay for TSI testing units so that students can become eligible for dual-credit courses. As noted earlier, in Texas, a student must be deemed "college ready" prior to enrolling in college-level coursework including dual credit. Districts cover the cost of TSI testing units, which must be purchased for students to take TSI assessments. Given the number of units each student takes, district administrators estimated that each dual-credit student generates a cost of approximately $20 for TSI testing units (5 to 10 TSI units across 2 to 3 subject areas). In District 1B, the annual cost of textbooks, dual-credit high school teacher stipends, and TSI units add up to $18 per semester credit hour, as shown in Table E.2. District 1B also covers tuition charges and transportation for early college students, which we discuss below. Because District 2B does not pay for textbooks or transportation and does not offer teacher stipends, the only costs beyond administration and advising (i.e., "other costs") are for TSI units, which amount to $4.25 per semester credit hour, shown in row 5 of Table E.2.

The cost to students for dual credit in District 1B is $17 per semester credit hour, which includes transportation, textbooks, and tuition (for courses ineligible for waivers or courses beyond the initial 12-course tuition waiver). Community College B administrators estimate that only 5% of all dual-credit courses are ineligible or are taken by students who have already passed the initial 12-

course tuition waiver, so this amounts to under $2 per semester credit hour. Students in District 2B incur a greater cost, $35 per semester credit hour, because the district does not pay for textbooks.

Tuition and Fees

As noted earlier, Community College B grants tuition waivers for the first 12 courses of dual credit. A limited number of courses are not eligible for the tuition waiver and these courses are determined on a case-by-case basis and vary from semester to semester. Community College B charges districts $100 per student per course in early college, which District 1B covers (District 2B does not have any early colleges). This fee is assessed because Community College B guarantees that early college students will have access to the courses necessary to complete an Associate's degree.

Differences in Cost Burden for Community College B, Its District Partners, and Students

As shown in Table E.2, Community College B pays for the majority of costs of dual credit (84% in District 1B and 111% in District 2B). Because districts save money through reduced teacher staffing requirement, the proportion of dual-credit costs that districts incur is much lower, amounting to only 19% in District 1B. The cost of dual credit is negative in both districts because the cost savings associated with dual credit is greater than the sum of all other costs. Moreover, in District 2B, Community College B actually incurs more costs per SCH than the total cost (111%) because of the limited DC staffing at the District 2B central office and at district high schools and because of the large cost savings incurred by the district through reduced teacher staffing. Students pay a total of 19.4% of costs in District 1B and 53.2% in District 2B. If we ignore the cost savings associated with reduced teacher staffing, the costs are more evenly spread across community colleges, school districts and students (45%, 45%, and 10% in District 1 and 49%, 25%, and 26% in District 2, respectively). Finally, because tuition fees are waived for the majority of dual credit in traditional comprehensive high schools, adding tuition to the cost calculations has little impact on differences in the cost burden of dual students.

Table E.2. Costs per Semester Credit Hour for Three School Districts Partnering With Community College B

Cost Category	District 1B		District 2B	
College Admin. and Advising	$32.08		$32.08	
College Instructional Personnel	$42.93		$40.57	
District and High School Admin and Advising	$58.54		$31.07	
High School Teacher Cost Savings	(80.33)		(77.28)	
District and High School Other Costs	$17.98		$4.25	
Cost to students	$17.12		$34.93	
College Cost Pre-Tuition	$75.01	84.9%	$72.64	110.7%
School District Cost Pre-Tuition	($3.81)	-4.3%	($41.96)	-63.9%
Student Cost Pre-Tuition	$17.12	19.4%	$34.93	53.2%
College Tuition (Revenue)	(1.67)		(1.67)	
District/HS Tuition	$0.00		$0.00	
Students Tuition	$1.67		$1.67	
College Cost Post-Tuition	$73.34	83.0%	$70.98	108.2%
School District Cost Post-Tuition	-$3.81	-4.3%	($41.96)	-63.9%
Student Cost Post-Tuition	$18.79	21.3%	$36.60	55.8%
Total Cost	$88.32		$65.62	

Note: Negative costs for school districts result from cost-savings associated with reduced teacher staffing (see text for further detail). When we omit these cost-savings, the annual cost per semester credit hour is $168 and $143, respectively, and the costs are more evenly spread across stakeholders. Tuition is only paid by students who enroll in more than 12 DC courses while in high school (all other tuition is waived); therefore, our results do not change substantially when the cost of tuition is included.

Costs for Community College C and Its District Partners

Community College C is a mid-sized community college located in an urban area. The college serves a total of 16 traditional school districts and two charter school districts, and uses full-time college faculty as instructors for most of its dual-credit education courses. Despite the large number of partnerships, almost half of all dual-credit semester credit hours that Community College C offers are directed to one large urban school district where there are eight high schools offering dual-credit courses. We collected data from two school districts that Community College C serves, which account for 56% of all dual-credit education courses for the community college. One of these, District 1C, was the large school district previously mentioned, while District 2C is relatively smaller serving only one high school. In this study, we calculated the total annual cost and cost per semester credit hour of dual credit for both school districts.

As Table E.3 shows, the total annual cost of dual-credit education per dual-credit semester hour that Community College C provides to District 1C is $113; this cost increases to $176 for District 2C. The main burden of these costs, once tuition cost is taken into account, primarily shifts from the districts to the college. Below, we describe in more detail the personnel and non-personnel resources and their associated costs that make up the total dual-credit education cost.

Community College Administrative and Advising Costs for Community College C

Community College C spends around $45 in administration and advising costs per dual-credit semester credit hour across all districts served. At Community College C, the dual-credit program is run by a Director of Dual Credit and Early College Programs. This Director oversees four Dual Credit and Early College Coordinators who are involved in the day-to-day communication and outreach to school districts and high schools. This includes maintaining relationships with high school counselors overseeing dual-credit students on the high school side, and providing information sessions about dual-credit programs at each high school. Within the Dual-Credit Program office, there is also a Workforce Programs Coordinator who manages any partnerships with high schools providing career and technical dual-credit courses. Additionally, there is a full time administrative assistant for the Dual-Credit Program Office. These staff members who spend all their time on dual-credit programs account for more than 70% of the total college administrative and advising costs.

In addition to these staff who spend all their time on dual credit and early college programs, there are other college administrative staff who devote some of their time toward overseeing and administering the dual credit and early college programs at Community College C. These staff include the 'Provost and Vice President for Academic Affairs', the 'Vice President for Student Affairs', three Deans of various departments, and the 'Director of Admissions'. These higher-level administrators were estimated to spend approximately 25% to 30% of their overall time on matters related to dual credit and early college programs. These higher-level administrators account for the bulk of the remaining administrative costs for dual credit.

Lastly, there are some non-personnel costs related to college administration and advising for dual credit. In total, these non-personnel costs account for only $1.14 per semester credit hour. The largest of these non-personnel costs is the cost of travel for administrative staff who go out to school districts and high schools for outreach visits.

School District Central Office and Site-Based Administrative and Advising Costs for District Partners of Community College C

The two school districts partnering with Community College C had substantially different school district central office and site-based administrative and advising costs. In District 1C, the large district with eight high schools offering dual credit, the administrative and advising costs for the district amounted to $73 per semester credit hour. In District 2C, these costs came to $97 per semester credit hour.

The scale of operations for the two districts seemingly played a large role in the difference. For District 1C, much of the administrative burden occurred at the district level. While there were no staff with dedicated positions related to dual credit, there were numerous staff in the central office who spent some of their time on the administration of dual credit. These individuals manage the district student records related to dual credit, making sure students are properly enrolled, enter grades for dual-credit students, and run the purchasing and warehousing of textbooks for dual credit. The district staff described that there are high volume time periods at the beginning of the fall and spring semesters where they spend a lot of time on dual credit, but in other parts of the year they devote relatively little time to dual credit. In addition, there are staff at each high school that devote some time to dual-credit administration, such as principals or vice principals and deans of instruction. In total, administrative costs in District 1C amounted to $15 per semester credit hour.

Because District 2C is a single high school district, the bulk of the administrative burden occurred at the high school, with the principal and a Dean of Instruction. Due to the devotion of more school-level time for administration and the lower number of semester credit hours, administrative costs per semester credit hour for District 2C amounted to $35.

On the advising side, each high school in District 1C has a counselor who devotes much of their time to dual credit. Each high school has a 'Dual-Credit Counselor' who serves as the point of contact between the high school and the college and also is responsible for coordinating testing for students, ensuring that students properly enroll, and advising students on course taking. In addition to these eight Dual-Credit Counselors, the other high school counselors were also involved in advising their caseloads of students in a more minor way. Counselors are also involved in monthly meetings that serve to update central office representatives on dual credit. Dual-credit advising costs for District 1C amounted to $58 per semester credit hour.

Similarly, District 2C has a 'Director of College and Career Readiness', who was a counselor overseeing dual credit at the high school. This individual does the bulk of dual-credit advising,

while the other school counselors play a secondary role. Dual-credit advising costs for District 2C came to $61 per semester credit hour.

Instructional Personnel Costs for Community College C and Its District Partners

Community College C covers most, if not all, of the instructional personnel costs for school Districts 1C and 2C. This is the result of almost all instructors delivering dual credit being college faculty as opposed to high school teachers. More than 80% of instructors teaching dual-credit students in Community College C were full-time faculty. As full-time college faculty are substantially more expensive than part-time faculty or high school teachers, the instructional costs per semester credit hour paid for by Community College C were relatively high compared with other colleges in our sample. In total, instructional costs amounted to $77 per semester credit hour.

We also made the assumption that if enough students take dual-credit courses from non-high school teachers, high schools should be able to reduce their own teaching staff. Our assumption is that every 720 semester credit hours offered in a traditional high school would reduce the need for high school teachers by one. This number was generated by the assumption that a high school teaching load is five periods and an average class size of 24 students. Additionally, we assumed that high schools would cut part of an FTE. So once a school hit 720 semester credit hours, they would lose one FTE teacher, but under 720 semester credit hours they would not lose any teachers. Using these assumptions, we calculated that District 1C would only lose one teacher while District 2 would lose two teachers. This results in a cost savings of almost $19 per semester credit hour in District 1C and $85 in District 2C. The difference is due to District 1C offering dual credit across numerous traditional high schools. Only one high school reached the 720-semester credit hour threshold. Despite offering less overall dual credit in District 2C, it was all through a single high school.

Other Costs for District Partners of Community College C and Its Students

Other costs for delivering dual-credit program to high school students might include textbook, testing, and transportation. These costs are mostly covered by the districts or the students themselves, and not the Community College. District 1C pays $5.09 per dual-credit semester hour for textbooks, which students are not required to pay for. The district covers the cost of testing for all students who are eligible for free or reduced-price lunch, otherwise students pay for the cost of testing. The district pays $1.13 while students pay $0.76 per dual-credit semester hour for testing. District 1C does not offer any bus transportation option to the community

college. The total for other costs for District 1C is $6.97 per dual-credit semester hour – amount which is shared by the district ($6.22) and students ($0.76).

In District 2C, other costs are largely split between the district and students. In District 2C, students cover the cost of textbooks for non-CTE classes which adds up to $22.22 per dual-credit semester hour. The district, however, covers the cost of testing ($3.91 per dual-credit semester hour). An additional cost in District 2C, not found in District 1C is the cost of bus transportation. In District 2C, a bus runs between the high school and the district twice a day. In total these other costs amount to $24 per semester credit hour for the district and $22 for students.

Tuition and Fees

Community College C charges a flat fee of $33 per semester credit hour – or $99 per three-credit course. Districts 1C and 2C differ in their approach to paying that fee. In District 1C, the district pays the fee for all free or reduced-price lunch students and early college high school students, while the students pay if they are not in either of those categories. In District 2C, the students pay for all academic dual-credit courses. In both districts, the community college bears the bulk of the cost burden prior to accounting for tuition and fees, while the district bears most of the burden after accounting for tuition and fees. Additionally, in District 2C, the tuition and fee arrangement along with textbooks being paid for by students places approximately 21% of the cost burden on students and their families.

Differences in Cost Burden for Community College C, Its District Partners, and Students

Community College C pays the larger amount of dual-credit costs in District 1C and 2C, contributing 79% and 51% of the costs, in each district respectively. Both districts benefit from reduced high school teacher staffing as the districts can hire less teachers when some of their students enroll in dual-credit courses. Before paying tuition, District 1C even makes 8.7% in savings from reduced staffing. However, given the district pays the larger bulk of the $33 tuition fees for its students, it ends up paying 14.3% of the total cost of dual-credit education. District 2C makes $90 in high school teacher cost savings and requires its students to pay the full tuition amount, but overall contributes a 17.6% to the cost of dual credit. Students in District 1C pay a total of 6.8%, whereas students in District 2C pay a total of 31%. If we ignore the cost savings that both high schools make, that shifts the burden of the larger sum of the cost to the districts. Not counting these savings, District 1C pays 52%, Community College C pays 44.2%, and students pay 3.8% of the costs of dual-credit education. In District 2C, these numbers become 45.5%, 33.7%, and 20.8% for the district, the college, and students, respectively.

Table E.3. Costs per Semester Credit Hour for Two School Districts Partnering With Community College C

Cost Category	District 1C		District 2C	
College Admin and Advising	$45.41		$45.41	
District and High School Admin and Advising	$73.00		$96.58	
Instructional Personnel	$77.08		$77.19	
High School Teacher Cost Savings	($89.10)		($90.19)	
District and High School Other Costs	$6.22		$24.41	
Costs to Students	$0.76		$22.22	
College Cost Pre-Tuition	$122.49	108.1%	$122.60	69.8%
School District Cost Pre-Tuition	($9.88)	-8.7%	$30.81	17.5%
Student Cost Pre-Tuition	$0.76	0.7%	$22.22	12.7%
College Tuition (Revenue)	($33.00)		($33.00)	
District/HS Tuition	$26.07		$0.00	
Students Tuition	$6.93		$33.00	
College Cost Post-Tuition	$89.49	78.9%	$89.60	51.0%
School District Cost Post-Tuition	$16.18	14.3%	$30.81	17.6%
Student Cost Post-Tuition	$7.69	6.8%	$55.22	31.4%
Total Cost	$113.36		$175.63	

Note: Negative costs for school districts result from cost-savings associated with reduced teacher staffing (see text for further detail). When we omit these cost-savings, the annual pre-tuition cost per semester credit hour is $202.47 in District 1 C and $265.82 in District 2C, and the costs are more spread across community colleges, school districts and students (61%, 39%, and 0.4% in District 1C, and 46%, 46%, and 8% in District 2C, respectively). The post-tuition cost after omitting cost-savings is 44%, 52% and 4% in District 1C, and 34% 46% and 21% in District 2C, respectively.

Costs for Community College D and Its District Partners

Community College D is a large community college in a rural area, serving a total of twenty traditional school districts. The College uses high school teachers as instructors for most of its dual-credit courses. We collected data from three of the largest school districts that partner with Community College D, and that collectively receive 30.5% of all the dual-credit education that the College provides in the region. For each site, we calculated the distribution of the total annual cost and cost per dual-credit semester hour.

As Table E.4 below shows, the total annual cost of dual-credit education per dual-credit semester hour that Community College D provides to District 1D is $165, to District 2D is $123,

and to District 3D is $145. Taking into account tuition fees, the districts in sites 1D and 3D are the primary payers for dual-credit education costs, spending $113 and $74, respectively, per dual-credit semester hour. In District 2D, the cost burden primarily falls on Community College D, which pays $53, and the district, which pays $47. Below, we describe in more detail the dual-credit personnel and nonpersonnel resources and their associated costs.

Community College Administrative and Advising Costs for Community College D

Community College D spends around $40.68 in administrative and advising costs across the three school districts in our sample. The Community College has a team of 15 members who dedicate some, or all, of their time to running the College's dual-credit program. The program is run by a 'Dual-Credit Outreach Director' who spends about 50% of their time on the program, and by two coordinators who solely work on dual-credit related activities. These staff consult with three school deans, each of whom spend an estimated 25% of their time on dual credit, and with a vice president of student and academic services, who spends 40% of their time on dual-credit related matters. The school also employed a faculty evaluator that helps—with approximately 70% of their time—in assessing high school teachers' ability to provide quality dual-credit classes. Other staff, such as two coordinators and a college administrator, dedicate all their time to the program.

Similar to other community colleges that provide dual-credit classes, Community College D also has non-personnel dual-credit costs related to administering the program. The non-personnel dual-credit costs include travel expenses to school districts for outreach and other purposes, orientation meetings and materials, and other office expenses such as ones used in trainings of the program's administrative staff.

School District Central Office and Site-Based Administrative and Advising Costs for District Partners of Community College D

The administrative and advising costs for the dual-credit program on the school district side, for districts in our sample that partner with Community College D, varied substantially. The cost of providing dual-credit education in District 1D was $74.01 per semester credit hour, while that amount was $39.25 in District 2D, and $66.03 in District 3D. The higher administrative and advising costs in District 1D could be the result of the smaller number of dual-credit students that the district serves, and subsequently the fewer dual-credit semester hours, that the district offers compared with the other districts. This smaller number of dual-credit semester hours leaves District 1D with relatively higher operational costs when these costs. Similarly, the pricier operational costs could also explain the difference in dual-credit administrative and advising

costs between District 2D and District 3D, as the latter offers a little over than half the semester credit hours that District 2D offers.

In terms of both personnel and non-personnel costs, District 1D had many staff, such as the principal, the director of programs, the athletic director, and a technology consultant, who contribute a little of their time to running the dual-credit program. District 2D and District 3D on the other hand had key persons, such as a college and career specialist and a director for Early College High Schools and CTE, who contribute most of their time to the program. There were other staff members who provide support for dual-credit programs in District 2D and 3D, however that level of support was minimal in District 2D. As for non-personnel costs, these were mainly used to cover enrollment activities' costs in all three Districts.

Instructional Personnel Costs for Community College D and Its District Partners

Instructional Personnel costs, similar to Administrative and Advising costs, were highest for District 1D:$52.91 per dual-credit semester hour. District 2D and District 3D were alike in this regard with costs of $40.97 and $39.38, respectively, per dual-credit semester hour. All districts in our sample use a distant learning model to deliver some dual-credit courses. In addition, the districts also have one or two high school teachers who teach dual-credit courses on the high school's campus. In Districts 1D and 3D, these teachers also offer other non-dual-credit courses at their high schools, so the districts do not pay those teachers any extra costs specifically for their instruction of dual-credit courses. On the other hand, District 2D provides a stipend for its high school teachers who teach dual-credit courses. Finally, both District 1D and 2D cover transportation costs for high school teachers when they visit the Community College for their professional development.

In district 2D, there was also enough dual-credit courses provided by non-high school teaching staff that could the district was able to reduce the amount of teaching staff in their district by one teacher. This results in a cost savings of $18.90 per dual-credit semester credit hour. The other districts had fewer dual-credit semester credit hours with a substantial percentage already taught by high school teachers. Therefore, they did not realize cost savings associated with reductions in high school teaching staff.

Other Costs for District Partners of Community College D and Its Students

Other costs related to the provision of dual-credit education in District 1D are $33.92, which are much higher than District 2D's $0.67 and District 3D's $22.22. These costs include those of textbooks, testing, and bus transportation. What sets out District 1D in this regard is that the

district provides the textbooks for its students at no cost, unlike District 2D and 3D. District 1D and 3D also incur student transportation costs to and from the community college, whereas District 2D does not cover such costs.

Tuition and Fees

Community College D has different arrangements with school districts for charging dual-credit courses tuition. The College charges District 2D a tuition of $28.74 per semester hour as a fixed cost to school districts per student per semester credit hour. Districts 1D and 3D, pay a tuition of $34.72 and $44.5 per semester credit hour, respectively. However, the arrangement is such that the two school districts buy a block of dual-credit courses from Community College D that are delivered on the districts' high school campuses. If either District 1D or 3D were to request additional courses beyond what is included in their purchase, , Community College D charges the market price for any extra course (approximately 11 times the cost of a course included in the bundle). Both Districts 1D and 2D waive tuition for students and take on the costs of the dual-credit courses, while District 3D requires its students to pay 85% of the tuition cost if they decide to take a certain class that is not included in the offered course package paid for by the school district.

Differences in Cost Burden for Community College D, Its District Partners, and Students

As Table E.4 below shows, Districts 1D and 3D pay the larger sum (68% and 51%, respectively) of the total cost of dual credit. In District 2D, Community College D covers 43% of the total cost, while the district covers 38%, and the students cover 19%. If we do not account for any high school teacher cost savings, which are savings from decreased high school staffing given students' enrollment in dual credit, some of the cost burden in District 2D shifts from the college to the district. District 2D in that case pays 47%, and Community College pays 36.5% of the total cost of dual credit. In Districts 1D and 3D, the distribution of burden is only exaggerated in that case as districts pay a larger sum (73% and 60%, respectively) of the total cost of dual credit. In the three districts, students' contribution only slightly changes to 2.9%, 16.2% and 20%, respectively, of the total amount per dual-credit semester hour.

Table E.4. Costs per Semester Credit Hour for Three School Districts Partnering With Community College D

Cost Category	District 1D		District 2D		District 3D	
College Admin and Advising	$40.68		$40.68		$40.68	
District and High School Admin and Advising	$74.01		$39.25		$66.03	
Instructional Personnel	$40.97		$40.97		$39.38	
High School Teacher Cost Savings	($29.96)		($22.09)		($31.79)	
District and High School Other Costs	$33.92		$0.67		$8.61	
Costs to Students	$5.67		$23.47		$22.22	
College Cost Pre-Tuition	$81.64	49.4%	$81.64	66.4%	$80.05	55.2%
School District Cost Pre-Tuition	$77.97	47.2%	$17.83	14.5%	$42.85	29.5%
Student Cost Pre-Tuition	$5.67	3.4%	$23.47	19.1%	$22.22	15.3%
College Tuition (Revenue)	($34.72)		($28.74)		($44.53)	
District/HS Tuition	$34.72		$28.74		$31.04	
Students Tuition	$0.00		$0.00		$13.48	
College Cost Post-Tuition	$46.92	28.4%	$52.90	43.0%	$35.53	24.5%
School District Cost Post-Tuition	$112.69	68.2%	$46.57	37.9%	$73.89	50.9%
Student Cost Post-Tuition	$5.67	3.4%	$23.47	19.1%	$35.71	24.6%
Total Cost	$165.28		$122.95		$145.12	

Note: Negative costs for school districts result from cost-savings associated with reduced teacher staffing (see text for further detail). When we omit these cost-savings, the annual cost per semester credit hour is $195, $145, and $177 respectively, and the pre-tuition costs are more evenly spread across community colleges, school districts and students (42%, 55%, and 3% in District 1D, 56%, 28% and 16% in District 2D, and 45%, 42%, and 13% in District 3D, respectively). When the cost of tuition is included, those percentages change to 24%, 73% and 3% in District 1D, 37%, 47% and 16% in District 2D, and 20%, 60% and 20% in District 3 respectively).

Costs for Community College E

Community College E is a medium-sized community college in a rural area, serving a total of thirty traditional school districts. In this site, we only looked at the cost of dual credit from the College's side.

Community College Administrative and Advising Costs for Community College E

Community College E spends about $23.20 per dual-credit semester hour in administrative and advising costs, as shown in Table E.5. The bulk of this amount is spent on administrative

personnel as the college has two staff members, a Director of Dual Credit and a Coordinator, who dedicate all their time to the program. The Dean of Instructional Administration at the college is also heavily involved in the program. In terms of advising costs, the college has a full-time staff member, on its advising services team, who attends to dual-credit students. Non-personnel costs for dual-credit staff and activities are kept to a minimum at Community College E.

Instructional Personnel Costs for Community College E

Community College E spends $69.78 per dual-credit semester hour on instructional personnel at the college. For districts that have high school teachers instruct the dual-credit courses, Community College E either pays those teachers a part-time faculty rate or it provides the districts with a stipend and lowers tuition fees for students. The college also provides those high school teachers with mentoring and teaching demonstrations opportunities, and invites them to teach summer classes at the college.

Table E.5. Costs per Semester Credit Hour at the College Level for Community College D

Cost Category	College
College Admin and Advising	$23.20
Instructional Personnel	$69.78
College Cost Pre-Tuition	**$94.33**
College Tuition	(50.00)
College Cost Post-Tuition	**$44.33**

Appendix F. English Language Arts Protocol

Data Analysis

AIR researchers identified the similarities and differences in content and skill expectations, instructional and assessment practices, and student performance across courses through a systematic analysis of the data. Four AIR researchers reviewed 22 sets of survey data, 19 syllabi, 52 assignments, and 124 student work samples for the purposes of the study. The researchers were trained to use the online protocols, using sample syllabi, assignments, and student work samples. The researchers conducted an initial analysis of the samples and then came together to discuss and calibrate findings. Researchers then examined the uploaded data; two researchers focused on the English syllabi, assignments, and student work samples, and two researchers concentrated on the mathematics syllabi, assignments, and student work samples. Two researchers examined each syllabus separately and later compared their responses and categorizations to reconcile any differences and produce one agreed upon representation of what was included in each syllabus. This then allowed for a baseline comparison of academic expectations among courses in the different modalities. Each assignment was reviewed by a single reviewer. After reviewing all assignments, the researchers who examined the English assignments met to ensure they had been using similar definitions of terms and were categorizing items similarly; likewise for the researchers working on mathematics assignments. The process for reviewing the 53 mathematics and 71 English student work samples was similar to the assignment review process. Reviewers initially worked together to review a sample set of student work to calibrate and build common definitions of the elements of the protocol. Each student work example was reviewed once by a single reviewer, and after examining all examples, researchers working in the same subject areas conferred to discuss any differences in approach or rating.

In April 2018, researchers came together in a full-day, face-to-face meeting to analyze all of the data collected. Researchers were guided through a collaborative analytic process that focused on understanding the data and data sources, identifying individual findings from each set of sources, and developing main findings based off of recurring patterns and common themes (Maxwell, 2013; Merriam, 1998). Each reviewer was assigned to focus on a specific course type and reviewed each data set from that perspective. Researchers identified individual data points from the data and posted them under the key themes for this part of the study; what is taught (content and skills expectations), how its taught (instructional strategies, assignments and assessments), and student performance. They then worked in teams to organize the data points into main findings for each content area. These main findings are the basis for this report.

Syllabus Review

Review of Syllabus – The purpose of the review of syllabi is to gather baseline information on academic expectations between dual-credit and college credit-only courses. The analysis will be based on the study team's review of course syllabi submitted by instructors of record for these courses. Please review the syllabus and respond to the following questions, accordingly.

Are the following skill objectives included in the syllabus?: Y/N/Unclear

Objectives	Yes	No	Unclear
Critical thinking skills			
Communication skills			
Teamwork			
Understand writing process (planning, drafting, revising, editing)			
Analyze purpose, audience, tone, style, and writing strategy when in written works			
Analyze various types of written works			
Develop computer literacy			
Command of grammatical structure			
Drawing conclusions			
Making inferences			

Does the syllabus cover the following topics?: Y/N/Unclear

Topics		Yes	No	Unclear
General	Text analysis			
	Source analysis			
	Research skills			
Essay/composition development	Idea development			
	Audience, purpose, and occasion			
	Individual and collaborative writing processes			

Topics		Yes	No	Unclear
	Thesis statement			
	Paragraph construction			
	Informative writing			
	Persuasive writing			
	Analytical writing			
	Use of appropriate citation methods (as stated by instructions)			
	Technical aspects of writing identify rhetorical purposes and methods of organization appropriate to topic, thesis, and audience			
	Revision strategies (individual and/or collaborative)			
Stages of writing process	Invention			
	Researching			
	Drafting			

Are the following components included in the syllabus?: Y/N/Unclear

- Homework expectations – including hours of time students should spend on homework
- Plagiarism policies
- Class participation
- Student conduct
- Attendance policies
- Prerequisites are listed
- Provisions for students with special needs are outlined
- Expectations for technology use
- Grading
  - Allowance of late work
  - Options for extra credit
  - Drop lowest test score

Are the following assignments included in the syllabus? Y/N/Unclear

		Yes	No	Unclear
Assignments	Papers/essays			
	Presentations			
	Readings			
	In-class assignments			
	Journals			
	Blogs			
	Peer reviews			
Reading requirements	Papers assigned			
	Books required			
	Literary texts			

Assignment Types

		Yes	No	Unclear
Assignments	Papers/essays			
	Presentations			
	In-class assignments			
	Journals			
	Blogs			
	Peer reviews			
Reading requirements	Books required			
	Papers assigned			
	Informational texts			
	Literacy texts			
	Other			

Are the following **Graded Elements** included in the syllabus and if so what percentage of the final course grade does it represent

Assignments	Not included	Under 10%	10%–20%	21%–30%	31%–40%	41%–50%
Quizzes						
Pop Quizzes						
Cumulative Final Exam						
End of Chapter tests						
Oral Exams						
Midterms						
Papers						
Presentations						
Homework						
Participation						
Research						
Case Studies						
Extra Credit						
Portfolio						

*percentages are the amount counted towards final grade—which should add up to 100%.

Assignment Review

STEP 1: Review the materials.

- Locate the assignment to be evaluated
- Locate the three student work that corresponds to the assignment.
- Scan the lesson/unit to see what it contains and how it is organized.
- Review the topic focus of the assignment

STEP 2: Identify which skill objectives(s) students will need to demonstrate or use in completing this assignment.

- ☐ Critical thinking Skills
- ☐ Communication Skills
- ☐ Teamwork
- ☐ Understand writing process (planning, drafting, revising, editing)
- ☐ Analyze purpose, audience, tone, style, and writing strategy when in written works
- ☐ Analyze various types of written works
- ☐ Develop computer literacy
- ☐ Draw conclusions from text
- ☐ Make inferences from text

STEP 3: Determine which level of cognitive complexity (what the assignment is actually asking the student to do with the content) the student is being asked to engage in (see appendix A for definitions and examples).

- ☐ 1: Interacting with new content (e.g., clarifying author's meaning)
- ☐ 2: Practicing and deepening new content (e.g., arguing about text, using evidence to support)
- ☐ 3: Cognitively complex tasks (e.g., expressing original and abstract ideas and using course texts to support those ideas)

STEP 4: Determine which level of cognitive demand (the degree or complexity of knowledge that the assignment requires) the student is being asked to engage in (see appendix B for definitions).

- ☐ Level 1
- ☐ Level 2
- ☐ Level 3
- ☐ Level 4

Review of Student Work

STEP 5: Determine what level the student work reflects on the novice-expert continuum (see appendix C for definitions).

- ☐ Emerging Expert
- ☐ Accomplished Strategic Thinker
- ☐ Strategic Thinker
- ☐ Emerging Strategic Thinker
- ☐ Accomplished Novice
- ☐ Novice Thinker
- ☐ Emerging Novice

Evidence:

Rubric measuring Cognitive Complexity

Categories	Definition	Examples
Interacting with new content	Students must actively process new information in order to retain it Students are given the opportunity to process small chunks of new content	• Previewing and processing new content • Identifying critical content, • Elaborating on new information, • Reflecting on learning • Summarizing and clarifying content
Practicing and deepening content	Students must have opportunities to practice skills and deepen their understanding of information. Deeper awareness is forged through repeated exposure to knowledge, involving practice and knowledge-deepening activities Students wrestling with content as they build the stamina required to reach higher levels of thinking	• Examining similarities and differences • Examining errors in reasoning • Reviewing and revising knowledge
Cognitively complex tasks	Work that requires students to think on their own or with peers as they refine higher-order thinking skills. For students, the core of effectively engaging with content in a more complex way and they have the ability to produce and support claims. At this level students are able to master a structured and rigorous method for producing and supporting claims that include these steps: (1) State a claim (2) Establish grounds (3) Provide backing (4) Frame qualifiers to include describing counter-arguments as well as identifying thinking errors	Hypothesis generation and testing, Investigating, Problem-solving, Decision-making Experimental inquiry Inventing and student-designed tasks

Cognitive Demand

ELA Cognitive Demand Framework

Level		Definition	Sample Activities	Verbs/Statements to look for
1	**Recall/ Reproduction**	Recall a fact, information, or procedure. Process information on a low level.	**a. Writing** • Listing/generating ideas or words prior to developing written composition (e.g., brainstorming, webbing) • Selecting or recalling appropriate vocabulary (words, phrases, idioms) to achieve intended meaning in writing • Writing simple sentences • Using punctuation marks and capitalization correctly in writing and editing • Using Standard English conventions in writing and editing to correct errors • Identifying misspelled words in a written passage • Applying conventional spelling patterns/rules to new situations in writing • Using resources (dictionary, thesaurus) to correct spelling in written passages • Using resources to identify Standard English grammatical structures for correction • Using resources to apply basic formats for documentation **b. Reading** • Identify or describe characters, setting, sequence of events Select appropriate words to use in context (e.g., content-specific words, shades of meaning) when intended meaning is clearly evident	**Statements:** • Provide or recall facts, terms, definitions, conventions • Locate literal answers in text • Identify relevant information • Explain simple concepts or routine procedures **Other potential verbs:** Cite, Define, Explain, Give Examples, Illustrate, List, Name, Quote, Report, Select, State

Level		Definition	Sample Activities	Verbs/Statements to look for
2	**Skill/ Concept**	Use information or conceptual knowledge, two or more steps	**a. Writing** • Note-taking or outlining as a means of organizing ideas for writing • Developing text which may be limited to one paragraph • Using simple organizational strategies to structure written work (e.g., basic paragraph form: indenting, main idea, supporting details; simple transitions) • Constructing a variety of sentence types (e.g., simple and compound, sentences with embedded phrases) • Writing summaries that contain the main idea of a reading selection and pertinent details or quotations • Demonstrating basic understanding and appropriate use of such reference materials as a dictionary, thesaurus, or web site • Editing final drafts of compositions for mechanics and conventions, including grammar, punctuation, and capitalization **b. Reading** • Make basic inferences or draw basic conclusions about information presented in text • Recognizing appropriate generalizations about text (e.g., possible titles, main ideas) • Identify and summarize the major events, problem, solution, conflicts in a literary text • Distinguish between fact and opinion • Describe the characteristics or features of various types of text • Locate information to answer questions related to explicit or implicit central ideas in informational texts • Identify use of literary devices (e.g., imagery, idioms, exaggeration)	**Statements:** • Show relationships • Apply a concept • Use context clues to identify the meaning of unfamiliar words • Describe the cause/effect of a particular event • Predict a logical outcome • Identify patterns in events or behavior **Other potential verbs:** Categorize, Classify, Compare, Construct, Describe, Determine, Distinguish, Explain, Extend, Extrapolate, Formulate, Generalize, Infer, Interpolate, Interpret, Modify, Observe, Organize, Predict, Relate, Represent, Show, Simplify, Sort, Use

Level		Definition	Sample Activities	Verbs/Statements to look for
3	**Strategic Thinking**	Requires reasoning, developing a plan or a sequence of steps, some complexity	**a. Writing** • Developing compositions that include multiple paragraphs • Using complex or varied sentence structures in written compositions • Demonstrating some synthesis and analysis in writing (making inferences; determining relationships; generalizing, or connecting ideas) • Showing awareness of audience and purpose through focus, organization, voice/tone • Using appropriate organizational text structures (e.g., description; chronology; proposition/support; compare/contrast; cause/effect) • Editing and revising to improve the quality and meaning of the composition • Supporting ideas with details, examples, quotations, text references, and/or citations • Revising final drafts to improve organization and precision of language to produce a logical progression of ideas • Summarizing information from multiple sources to address a specific topic **b. Reading** • Explain, generalize, or connect ideas, using supporting evidence from the text or from other sources • Draw inferences about author's purpose, author's message or theme (explicit or implied) • Make and support inferences about implied causes and effects • Describe how word choice, point of view, or bias affects the interpretation of a reading selection • Summarize or compare information within and across text passages • Analyze interrelationships among elements of the text (plot, subplots, characters, setting) • Analyze or interpret use of author's craft (literary devices) to analyze or critique a literary text	**Statements:** • Explain phenomena in terms of concepts • Support ideas with details and examples • Compile information from multiple sources to address a specific topic • Develop a logical argument • Identify and justify a solution • Identify the author's purpose and explain how it affects interpretation of a reading selection **Other potential verbs:** Appraise, Assess, Cite evidence, Compare, Compile, Conclude, Contrast, Critique, Decide, Defend, Describe, Develop, Differentiate, Distinguish, Examine, Formulate, Identify, Infer, Interpret, Investigate, Judge, Justify, Reorganize, Support

Level		Definition	Sample Activities	Verbs/Statements to look for
4	**Extended Thinking**	Requires an investigation, time to think and process multiple conditions of the problem.	**a. Writing** • Developing multi- paragraph compositions that demonstrate synthesis and analysis of complex ideas or themes • Analyzing author's craft (e.g., style, bias, literary techniques, point of view) • Demonstrating evidence of a deep awareness of purpose and intended audience. (e.g., in informational reports including hypotheses and supporting evidence) • Creating compositions that demonstrate a distinct voice and that stimulate the reader or listener to consider new perspectives on the addressed ideas or themes • Writing an analysis of two selections, identifying the common theme and generating a purpose that is appropriate for both • Gathering, analyzing, and evaluating written information for the purpose of drafting a reasoned report that supports and appropriately illustrates inferences and conclusions drawn **b. Reading** • Compare or analyze multiple works by the same author, including authors' craft • Compare or analyze multiple works from the same time period or from the same genre • Gather, analyze, organize, and interpret information from multiple (print and non-print) sources for the purpose of drafting a reasoned report • Evaluate the relevancy and accuracy of information from multiple sources	**Statements:** • Synthesize ideas into new concepts • Connect common themes across texts from different cultures or areas • Synthesize information from multiple sources **Other potential verbs:** Appraise, Connect, Critique, Judge, Justify, Prove, Report, Synthesize

Novice-Expert Continuum

Categories	Definition
Emerging Expert	☐ Ability to apply knowledge in a variety of context ☐ Holistic understanding of subject matter rather than fractional understanding of subject matter ☐ Abstract thinking and strong ability to synthesize and integrate information ☐ Developed? "Conceptual understanding"—the why
Accomplished Strategic Thinker	☐ Ability to apply abstract thinking, ability to synthesize and integrate variety of sources and information ☐ Command of "conditional knowledge" – the when—when to apply the knowledge ☐ Developing holistic understanding of subject matter rather than fractional understanding of subject matter ☐ Developing "conceptual knowledge" – the why
Strategic Thinker	☐ Able to apply insight, idea generation, concept formation and integrate different subjects/topics ☐ Deep understanding of subject matter ☐ Developing abstract thinking, analytical skills and ability to synthesize/integrate information ☐ Developing command of "conditional knowledge" – the when—when to apply the knowledge
Emerging Strategic Thinker	☐ Developing ability to apply insight, idea generation, concept formation and integrate different subjects/topics ☐ Able to analyze information and discern patterns in information due to familiarity with subject ☐ Command of "procedural knowledge" – the how
Accomplished Novice	☐ Connecting subject matter to big ideas, aware of complexity of subject ☐ Developing contextual knowledge ☐ Meets basic expectations and guidelines ☐ Ability to interpret and apply information ☐ Demonstrates "declarative/descriptive knowledge" – the what
Novice Thinker	☐ Superficial understanding of subject area, concept formation, solution seeking skills ☐ Developing ability to interpret and discern rules and guidelines regarding basic standards
Emerging Novice	☐ Limited background in subject area, minimal contextual understanding of subject ☐ Developing ability to meet basic standards and requirements

Appendix G. Mathematics Protocol

Syllabus Review

Review of Syllabus – The purpose of the review of syllabi is to gather baseline information on academic expectations between dual-credit and college credit-only courses. The analysis will be based on the study team's review of course syllabi submitted by instructors of record for these courses. Please review the syllabus and respond to the following questions, accordingly.

Does the syllabus cover the following topics?: Y/N/Unclear (will be set up as a table in an online platform)

- Polynomial
- Rational functions
- Radical functions
- Exponential functions
- Logarithmic functions
- Systems of equations using matrices
- Graphing
- Non-linear inequities
- Sequences and series
- Circles
- Binomial Theorem
- Number systems
- Real number system
- Probability
- Conics

Are the following skill objectives included in the syllabus?: Y/N/Unclear

- Critical thinking skills
- Communication skills
- Empirical and quantitative skills

Are the following components included in the syllabus?: Y/N/Unclear

- Homework expectations – including hours of time students should spend on homework
- Plagiarism policies
- Class participation
- Student conduct
- Attendance policies
- Prerequisites are listed
- Provisions for students with special needs are outlined
- Expectations for technology use

- Grading
  - Allowance of late work
  - Options for extra credit
  - Drop lowest test score

Are the following assignments included in the syllabus?: Y/N/Unclear

Assignments

- Problem sets
- Presentations
- Reading
- Projects
- In class assignments
- Blogs
- Peer reviews
- Other

Are the following **Graded Elements** included in the syllabus and if so what percentage is given to the element

Assignments	Not included	Under 10%	10%–20%	21%–30%	31%–40%	41%–50%
Quizzes						
Pop Quizzes						
Cumulative Final Exam						
End of Chapter tests						
Oral Exams						
Midterms						
Projects						
Papers						
Presentations						
Homework						
Participation						
Research						
Case Studies						
Extra Credit						
Portfolio						
Other						

*percentages are the amount counted toward final grade

Assignment Review

STEP 1: Review the Materials.

- Locate the assignment to be evaluated
- Locate the student work that corresponds to the assignment.
- Scan the lesson/unit to see what it contains and how it is organized.
- Review the topic focus of the assignment

STEP 2: Identify which skill objectives(s) students will need to demonstrate or use in completing this assignment.

- ☐ Critical thinking Skills
- ☐ Communication Skills
- ☐ Empirical and quantitative skills

STEP 3: Determine which level of cognitive complexity (what the assignment is actually asking the student to do with the content) **the student is being asked to engage in (see appendix A for definitions and examples).**

- ☐ 1: Interacting with new content
- ☐ 2: Practicing and deepening new content
- ☐ 3: Cognitively complex tasks

STEP 4: Determine which level of cognitive demand (the degree or complexity of knowledge that the assignment requires) **the student is being asked to engage in (see appendix B for definitions).**

- ☐ Level 1
- ☐ Level 2
- ☐ Level 3
- ☐ Level 4

Student Work

STEP 5: Determine what level the student work reflects on the novice-expert continuum (see appendix C for definitions).

- ☐ Emerging Expert
- ☐ Accomplished Strategic Thinker
- ☐ Strategic Thinker
- ☐ Emerging Strategic Thinker
- ☐ Accomplished Novice
- ☐ Novice Thinker
- ☐ Emerging Novice

Evidence:

Cognitive Complexity

Categories	Definition	Examples
Interacting with new content	Students must actively process new information in order to retain it Students are given the opportunity to process small chunks of new content	• Previewing and processing new content • Identifying critical content, • Elaborating on new information, • Reflecting on learning • Summarizing and clarifying content
Practicing and deepening content	Students must have opportunities to practice skills and deepen their understanding of information. Deeper awareness is forged through repeated exposure to knowledge, involving practice and knowledge-deepening activities Students wrestling with content as they build the stamina required to reach higher levels of thinking	• Examining similarities and differences • Examining errors in reasoning • Reviewing and revising knowledge
Cognitively complex tasks	Work that requires students to think on their own or with peers as they refine higher-order thinking skills with few interruptions by the teacher For students, the core of effectively engaging with content in a more complex way and they have the ability to produce and support claims. At this level students are able to master a structured and rigorous method for producing and supporting claims that include these steps: (1) State a claim (2) Establish grounds (3) Provide backing (4) Frame qualifiers to include describing counter-arguments as well as identifying thinking errors	Hypothesis generation and testing, Investigating, Problem-solving, Decision-making Experimental inquiry Inventing and student-designed tasks

Cognitive Demand

Mathematics Cognitive Demand Framework

Level		Definition	Sample Activities	Verbs/Statements to look for
1	**Recall/ Reproduction**	Recall a fact, information, or procedure. Process information on a low level	• Recall or recognize a fact, definitions, or term • Apply a well-known algorithm • Perform a specified or routine procedure • Evaluate an expression • Solve linear equations • Identify a plane or three dimensional figure • Determine the area or perimeter of rectangle or triangles given a drawing and labels	**Verbs:** Calculate, Draw, Label, Locate, List, Match, Measure, Perform, Select, Tabulate, Recall, Identify, Recognize, Use
2	**Skill/Concept**	Use information or conceptual knowledge, two or more steps	• Classify planes and three dimensional figures • Use models to represent mathematical concepts • Solve a routine problem requiring multiple steps, or the application of multiple concepts • Compare and contrast figures • Compare figures or statements • Provide justifications for steps in a solution process • Extend a pattern • Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps • Translate between tables, graphs, words and symbolic notation • Select a procedure according to criteria and perform it	**Verbs:** Apply, Calculate, Categorize, Classify, Compute, Construct, Convert, Estimate, Find, Graph, Identify patterns, Predict, Relate, Represent, Show, Simplify, Solve, Sort, Use, Organize, Make Observations, Collect and Display Data, Compare Data

Level		Definition	Sample Activities	Verbs/Statements to look for
3	**Strategic Thinking**	Requires reasoning, developing a plan or a sequence of steps, some complexity	• Interpret information from a complex graph • Explain thinking when more than one response is possible • Make and/or justify conjectures • Develop logical arguments from a concept • Use concepts to solve problems • Perform procedure with multiple steps and multiple decision points • Generalize a pattern • Describe, compare, and contrast solution methods • Formulate a mathematical model for a complex situation • Provide mathematical justifications • Solve a multiple-step problem supported with a mathematical explanation that justifies the answer • Formulate an original problem, given a situation	**Verbs:** Check, Critique, Decide, Develop, Differentiate, Explain how, Formulate, Hypothesize, Interpret, Identify, Judge, Justify, Reorganize, Solve, Support
4	**Extended Thinking**	Requires an investigation, time to think and process multiple conditions of the problem.	• Relate mathematical concepts to other content areas • Relate mathematical concepts to real-world applications in new situations • Apply a mathematical model to illuminate a problem or situation • Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results • Design a mathematical model to inform and solve a practical or abstract situation ***NOTE**: Level 4 requires applying one approach among many to solve problems. Involves complex restructuring of data, establishing and evaluating criteria to solve problems*	**Verbs:** Appraise, Connect, Create, Critique, Design, Judge, Justify, Prove, Report, Synthesize

Novice-Expert Continuum

Categories	Definition
Emerging Expert	☐ Ability to apply knowledge in a variety of context ☐ Holistic understanding of subject matter rather than fractional understanding of subject matter ☐ Abstract thinking and strong ability to synthesize and integrate information ☐ Developed? "Conceptual understanding"—the why
Accomplished Strategic Thinker	☐ Ability to apply abstract thinking, ability to synthesize and integrate variety of sources and information ☐ Command of "conditional knowledge" – the when—when to apply the knowledge ☐ Developing holistic understanding of subject matter rather than fractional understanding of subject matter ☐ Developing "conceptual knowledge" – the why
Strategic Thinker	☐ Able to apply insight, idea generation, concept formation and integrate different subjects/topics ☐ Deep understanding of subject matter ☐ Developing abstract thinking, analytical skills and ability to synthesize/integrate information ☐ Developing command of "conditional knowledge" – the when—when to apply the knowledge
Emerging Strategic Thinker	☐ Developing ability to apply insight, idea generation, concept formation and integrate different subjects/topics ☐ Able to analyze information and discern patterns in information due to familiarity with subject ☐ Command of "procedural knowledge" – the how
Accomplished Novice	☐ Connecting subject matter to big ideas, aware of complexity of subject ☐ Developing contextual knowledge ☐ Meets basic expectations and guidelines ☐ Ability to interpret and apply information ☐ Demonstrates "declarative/descriptive knowledge" – the what
Novice Thinker	☐ Superficial understanding of subject area, concept formation, solution seeking skills ☐ Developing ability to interpret and discern rules and guidelines regarding basic standards
Emerging Novice	☐ Limited background in subject area, minimal contextual understanding of subject ☐ Developing ability to meet basic standards and requirements

Appendix H. Summary of DC Report Public Comment Feedback

Concerns/Recommendations	Count
Reporting Style/Organization of Report	
"Blacks" should be referred to as "Black students" in the report as Whites and Hispanics are referred to "White students" and "Hispanic students"	1
Descriptions of differences in race in the report's Exec Summary are less neutral and more charged than the descriptions embedded in the chapter of the report (see very specific comments/examples from Educate Texas)	1
Rewrite Exec Summary to elevate key findings about course rigor and outcomes among students enrolling in larger doses of DC	6
Language in many of the summarized findings carries an air of subjectivity	1
Frame report to put larger emphasis on causal impact of DC relative to the goals of 60x30TX, and acknowledge benefits of DC in addition to shortcomings	2
Emphasize more strongly the finding that on average, the benefits of DC far exceeded the cost	1
Make additional efforts, particularly in Exec Summary, introductions, and conclusions to make it clear causal impact study does not include ECHS and that study presents local average treatment effects	1
Include highlights of dosage study (pp. 196-212) in body of report	1
Ensure consistency in reporting of overall effect sizes throughout summary sections of report	1
With regard to HB 505 study, Reevaluate conclusions draw regarding rigor	1
Clarify number of years of HB 505 data analyzed earlier in the report in the data section	1
Reporting language overstates increases in DC participation (see specific comments/examples from Educate Texas)	1
Clarify how semester numbers are reported and/or provide context (see specific comments/examples from Educate Texas)	1
Reframe headline finding that "DC course offerings among ninth and 10th graders are rarely within the academic core" to be more attuned to the parameters within which schools are operating (see p. 40 of report and specific comments/examples from Educate Texas)	1
Concern about accuracy of finding/reporting that "Academic preparation of ninth and tenth grader DC participants has declined since HB 505" given that DC students score higher on average than non DC students; similar concern regarding finding that suggestive evidence indicates decline in DC standards for ninth and 10th graders (see specific comments/examples from Educate Texas)	2

Concerns/Recommendations	Count
Exclusion of ECHS	
Exclusion of ECHS results in an incomplete picture of DC, particularly with respect to underrepresented groups of students	24
IV Methods to Predict Impact of DC	
Concern about use of dual-credit class participation to predict probability of earning DC, then using predicted probability score instead of data that identified who earned DC—recommend replacing methodology with one which better reflects students who earned DC	14
Recommend more discussion and documentation of how the IV was selected, including alternatives considered	1
Recommend further empirical testing of the methodology and IV selected on other data (e.g. ECHS students or DC students in other states)	1
Other Methodological Concerns	
Explicitly communicate the limitations of the sample and how state policy based on its findings should not be done without balancing the findings of studies focused on other DC students (e.g. ECHS students and DC students taking courses at 4 years)	1
Study should identify the following types of students: AP, DC only, AP and DC ,and students receiving no exposure to AP or DC during HS OR student should remove AP and IB student data from the non DC group	2
Consider including four-year institutions in analyses	3
Use the most recent cohorts of data (2009-2016) to determine whether or not most current policies and practices are having an impact on students	2
Difficult to pinpoint "traditional" DC education programs in current context of DC in the state—recommend report examines all types of DC programs, including all forms of DC offered by universities, ECHS, etc.	2
Study should consider using THECB standards for measuring student success outcomes (4-year degree completion), and consider using additional short-term outcomes (first-year retention and first-year GPA)	1
Include ninth and 10th graders in DC	2
Include CTE students	1
Study did not include/mention impact of HB 5 on DC and specifically the impact on different demographic groups since the bill led to an increase in technical course offerings	1

Concerns/Recommendations	Count
Course Rigor Study	
Would like to know what percentage of dual-credit students in Texas are taught by high-school teachers. Also, how were the dual-credit students taught by the three high-school teachers chosen? For example, were they from an affluent school district and, therefore, probably more college ready?	1
Concern about small sample size and research design for examining/assessing rigor (see TCC comments)	1
Inaccuracies in Data	
Concerned demographic information for HCC is not accurate (see chart on p. 23)	1
EDUC 1300 and ARTS 1301 are inaccurately classified in the report as outside the Core	1
Focusing on obtaining associate's degrees as an outcome may be misleading since transfer students often never obtain them	1
Areas that Lacked Sufficient Focus	
With regard to HB 505, the study does not include enough information to adequately explain the increase in dual credit, how we see dual credit emerge across the state in different contexts, and the impact on student success	2
CTE DC opportunities and their benefits	1
Regional breakdowns would provide more accurate data reflective of DC student population	4
Data does not look deeper at differentiation by student socioeconomic status	2
Data does not look deeper at differentiation by availability of DC options within districts	2
Concerned that data were not presented on student performance in higher level college courses taken subsequent to DC coursework	1
Report should include additional context about the number of ECHS or ECHS students before and after HB 505 if possible	1
Report should include context about the amount of DC delivered through CCs and the demographics of students attending CCS	1
Need to emphasize more findings that highlight whether students and families benefit from DC and are there academic and economic benefits to earning DC	1
Implications for and Policy/Practice Recommendations	
Implications for the highly mobile student (e.g. military students) with respect to transferability, applicability to post-sec program, quality and consistency of DC courses (reviewer recommends AP and IB over DC for highly mobile students for this reason—report lacks attention to this	1

Concerns/Recommendations	Count
Include policy recommendations that as high schools work on assessing college readiness in ninth grade to assess properly which students are academically and emotionally prepared for college level courses	1
What is psychological impact and emotional readiness of ninth- and 10th-grade students enrolled in DC?	1
What are the implications/what is the future of the high school diploma? Should more emphasis be placed on junior high graduation and commencement?	1
Suggest including recommendations on how to decrease/dissolve racial disparities in DC	1
Attention should be given to the need for more degree planning for DC and ECHS students (note recent Pathways movement in TX) as a potential solution	4
Suggest report includes recommendation for further studies on rigor	3
Suggest report includes recommendation for further research on why DC benefits channel to two years instead of four years (see specific comments/examples from Educate Texas)	1
Suggest recommendations for state policies and funding solutions to ensure there aren't inequities with the number of academic advisors and the quality of advising to ensure students taking DC are advised to take courses toward their chosen degree	1
Suggest further exploration of the student financial costs incurred by students and their parents not taking DC courses due to financial hardships	1
Miscellaneous	
Task Force did not have adequate CC representation	1
Suggestions for rewording particular statements within the report	1

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