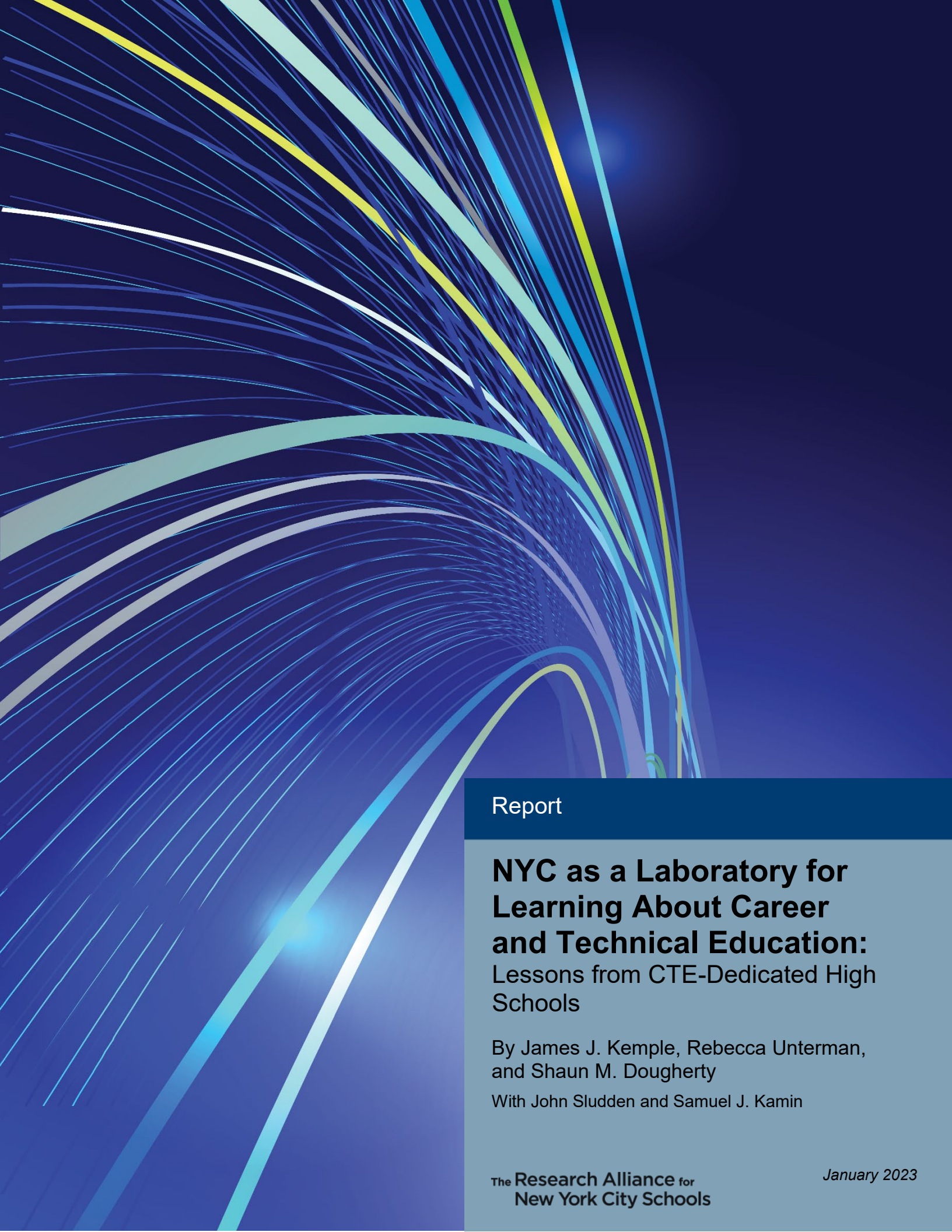

Report

NYC as a Laboratory for Learning About Career and Technical Education:

Lessons from CTE-Dedicated High Schools

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With John Sludden and Samuel J. Kamin

The Research Alliance for New York City Schools

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About the Research Alliance

Housed at NYU Steinhardt, the Research Alliance for New York City Schools is an independent, nonpartisan research center that conducts rigorous studies on topics that matter to the City's public schools. We strive to advance excellence and equity in education by providing evidence about the policies and practices that promote students' development and academic success.

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NYC as a Laboratory for Learning About Career and Technical Education: Lessons from CTE-Dedicated High Schools

During the last decade, Career and Technical Education (CTE) has re-taken a prominent place in education policy, at federal, state, and local levels. In contrast to more traditional approaches to "vocational education," many of these initiatives have explicitly focused on preparing students for both college and a career. Yet, there is still relatively little rigorous evidence about the impact of this new generation of CTE programs, the long-term trajectories of the students who attend them, or the effectiveness of various strategies being used to support students' transitions into college and the labor market.

New York City is an especially rich context within which to learn about CTE.[1] With more than 290 CTE programs across 131 high schools, the NYC Department of Education (NYCDOE) oversees one of the largest and most diverse CTE systems in the country. In the last year, NYC's mayor and NYCDOE leadership have made a number of new investments in Career and Technical Education.[2] Their work has been oriented around a "North Star" goal of having all students in the City "graduate with a pathway to a rewarding career, long-term economic security, and equipped to be a positive force for change." [3] This commitment has been codified in the formation of the "Office of Student Pathways," which oversees all postsecondary readiness and work-based learning initiatives.

The Research Alliance for New York City Schools, in collaboration with researchers from MDRC, Boston College, and the University of Connecticut, has undertaken a multi-year study that looks to New York City as a laboratory for learning about the implementation, impact, and cost of the wide array of educational options that fall under the heading of Career and Technical Education. Evidence from this ongoing study is informing the work of the Office of Student Pathways, which includes the team that centrally manages CTE in particular. Given the wide-ranging conditions under which CTE is implemented in NYC, and the diversity of students it serves, the study has the potential to inform policy and programming decisions across the country.

This report is the first of several that will emerge from the larger study. Here, we focus on **CTE-Dedicated high schools** that were available to rising 9th graders in New York City between 2013 and 2016. CTE-Dedicated high schools are structured to ensure that all enrolled students participate in a CTE Program of Study throughout Grades 9 through 12. These programs are organized around an industry-aligned theme (e.g., construction, IT, health services, etc.) and offer a sequence of career-focused courses, work-based learning opportunities, and access to college-level coursework. Career-focused courses are taught by CTE-certified teachers. The programs form partnerships with employers and postsecondary educational institutions to provide access to work-based learning and college courses, respectively. [4]

Students who attend the City's CTE-Dedicated high schools are a large and diverse group. Between 2013 and 2016, for example, nearly 40,000 8th grade students applied and were assigned to 47 CTE-Dedicated high schools through the City's High School Application

Processing System (HSAPS). This represents more than a quarter of all high school applicants during this period. This group of students was about 43 percent Latinx, 32 percent Black, 12 percent Asian, and 7 percent White (compared to 38 percent Latinx, 26 percent Black, 15 percent Asian, and 14 percent White for high schools citywide). Students who applied to and were assigned to a CTE-Dedicated high school were somewhat more likely to be living in poverty (72 percent, versus 68 percent citywide) and slightly less likely to have a home language other than English (38 percent, versus 41 percent citywide). Young men were overrepresented in the CTE-Dedicated high schools compared to high schools citywide (63 percent, versus 53 percent). Students entered CTE-Dedicated high schools with similar levels of middle school attendance and somewhat lower 8th grade state test scores than citywide averages. (See Table 2 on page 17 for additional information about the characteristics of students in CTE-Dedicated high schools and their contrast with students in other NYC high schools during the study period.)

CTE-Dedicated Versus Comprehensive High Schools

The NYCDOE offers CTE Programs of Study in two different high school contexts: 1) CTE-Dedicated high schools that are committed to ensuring that all enrolled students are exposed to the full range of CTE programming and experiences, and 2) Comprehensive high schools, in which students may choose to enroll in CTE or other options as they progress from 9th through 12th grade. This report focuses on CTE-Dedicated high schools, where students typically begin their CTE coursework and experiences in the 9th grade, receiving guidance about how to fulfill the requirements of both a Regents diploma and a CTE-specific credential. A subsequent report will examine CTE programs offered in Comprehensive high schools.

About This Report

In this report, we assess the impact of the CTE-Dedicated high schools on key student outcomes, including academic engagement in 9th through 12th grade, high school graduation, and college enrollment. We also examine the degree to which key program elements were available to students in CTE-Dedicated high schools, highlighting policies and programming decisions that shaped the orientation and impact of these programs during the study period.

The sample for these analyses includes 37 of the City's CTE-Dedicated high schools and nearly 19,000 students who applied to and were assigned to those schools through HSAPS between 2013 and 2016.[5] This analysis uses an especially rigorous approach to compare the experiences and outcomes of students who were assigned to a CTE-Dedicated high school with those of similar students who also applied to CTE programs but were assigned to another high school as part of the HSAPS process. While many studies have looked at the outcomes of students who participate in CTE, our research design allows us to discern *the difference that the CTE programs are making—if any*—above and beyond what students would have achieved had they been assigned to a non-CTE option. Outcomes data are available through Fall of 2021, which allows us to follow students through high school and for a year and a half after their scheduled high school graduation. (See page 15 for more information about the study's data sources and methods.)

An Important Note

While the current analysis provides valuable insight about students' experiences in high school and their transition to college, the picture presented by the available data is necessarily incomplete. First, we have only a year and a half of postsecondary education data for students in the sample, which means we don't know much about their longer-term persistence and success in college. Second, we do not yet have data on postsecondary employment, leaving key questions unanswered about whether students worked instead of, or in addition to, going to college. The findings we do present attempt to identify CTE program pathways that may help some students enroll in college immediately after high school and other pathways that may enable some students to enter the labor market directly. But there is still much to be learned about the longer-term effects of the programs in our study—particularly the extent to which they have helped students gain access to high-quality jobs with family-sustaining wages. This is work we hope to undertake in the future.

Finally, it is important to emphasize that rather than a summative evaluation of the overall effectiveness of NYC's CTE system, this study seeks to capitalize on NYC as a laboratory for learning about the conditions under which CTE may be most and least effective and for whom. The extraordinary diversity of NYC's CTE landscape and its student population provides a unique opportunity to gather information about program implementation, quality, accessibility, and costs, and about how these factors influence CTE's impacts on students' college and career readiness.

Overall Findings

CTE Implementation and Students' Exposure to Key Program Components

The New York State Education Department (NYSED) requires all school districts to offer CTE Programs of Study consisting of the following elements: [6]

- A sequence of three or more full-year courses organized around a designated career theme vetted by experts;
- Work-based learning opportunities for students in their specific field of study;
- Teachers with appropriate state certifications, licenses, and preexisting industry experience;
- The opportunity for students to earn industry-recognized credentials; and
- Postsecondary education and industry partnerships and articulation.

CTE Programs of Study are expected to provide connections to local employers and other experiences that help prepare students for postsecondary careers as well as higher education. Students in CTE programs have to pass specific CTE courses and technical assessments of their occupational skills and complete work-based learning experiences, in addition to meeting the same academic standards and passing the same demanding high school exit exams required of all NYC students.

We examined the implementation of 106 Programs of Study in 37 CTE-Dedicated high schools, drawing largely on a review of Program Accountability Forms (PAFs) submitted by schools to the NYCDOE.[7] Among our key findings:

On average, the CTE-Dedicated high schools provided the required elements, but there was substantial variation across schools and programs.

On average, the CTE Programs of Study offered 11 CTE course credits (four credits are required for CTE concentration by federal policy, and seven are required by New York State) and at least two work-based learning activities per grade. The average CTE Program of Study had at least three CTE-certified teachers and engaged in partnerships with at least two employers and one postsecondary educational institution. Approximately two thirds of the Programs of Study had received NYSED certification, and several others appear to have met the criteria for certification but were still awaiting approval or had not yet submitted a request for certification.[8]

These findings suggest that the Programs of Study available in these 37 CTE-Dedicated high schools were generally implementing the core elements required by NYSED and the NYCDOE. However, the averages mask considerable variation across schools and programs. For example, the CTE Programs of Study in 15 of the high schools offered more than 10 CTE credits, while those in two of the high schools offered fewer than four CTE credits. Similarly, the CTE programs in 15 of the high schools offered an average of three or more work-based learning activities per grade, while those in six of the high schools did not offer any work-based learning activity in at least one grade.

A majority of students assigned to CTE-Dedicated high schools completed the required number of CTE credits, and about one quarter participated in a work-based internship.

As shown in Table 1 below, 56 percent of the students assigned to a CTE-Dedicated high school earned six or more CTE credits, and 64 percent earned four or more credits (i.e., the state requirement for CTE concentration).[9] Approximately 22 percent of the students participated in a paid or credit-bearing work-based internship, the most intensive type of work-based learning experience. While these rates are substantially higher than for students who were not assigned to a CTE-Dedicated high school—indicating that programs had a large, positive effect on students' exposure to CTE coursework and work-based learning—it is clear that many students in the CTE-Dedicated high schools were not completing the most intensive elements of a CTE Program of Study.

Reflecting a particularly challenging feature of CTE programming, a full three quarters of the CTE students did not participate in a paid or credit-bearing internship, based on the data available.[10] It should be noted, however, that the data we have on internships only includes those for which students received course credit or were paid through the DOE Internship Management System. This does not include internships that may have occurred through the City's Summer Youth Employment Program or been managed through other DOE vendors. As we address in the "Discussions and Implications" section below, this highlights the need for better, more consistent tracking of students' participation in work-based learning.

Table 1: Impacts of CTE-Dedicated High Schools on Students' Exposure to CTE Programming

Outcomes	CTE Group	Control Group	Impact	
CTE Course Credits Earned				
Any CTE Course Credits (%)	84.9	44.6	40.3	*
Average Number of CTE Credits	8.3	1.3	7.0	*
Four or More CTE Credits (%)	63.5	11.4	52.2	*
Six or More CTE Credits (%)	55.7	5.6	50.1	*
Internship Participation (%)				
Paid or Credit for Internship	22.3	13.2	9.1	*
Paid Internship	11.7	1.0	10.7	*
Course Credit for Internship	13.9	12.5	1.4	
CTE Course Credit for Internship	10.4	5.6	4.8	*
Other Course Credit Internship	4.2	8.3	-4.1	*
College Courses				
Attempted College Course (%)	20.9	21.3	-0.4	
Passed College Course (%)	19.7	20.2	-0.5	
Avg. # of College Courses Passed	0.4	0.7	-0.3	*
Sample Size	16,623	16,303		

Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 20.

As with the variation observed in Program of Study offerings, there was substantial variation in the number of CTE credits that students earned, as well as their participation in internships, across the 37 schools in the sample. For example, in 11 schools, at least 70 percent of the students completed four or more CTE credits, while in 12 of the schools less than half of students did so. In only two of the high schools, at least 50 percent of students participated in a paid internship or received credit for an internship, while in four schools, the rate of participation was 10 percent or less.

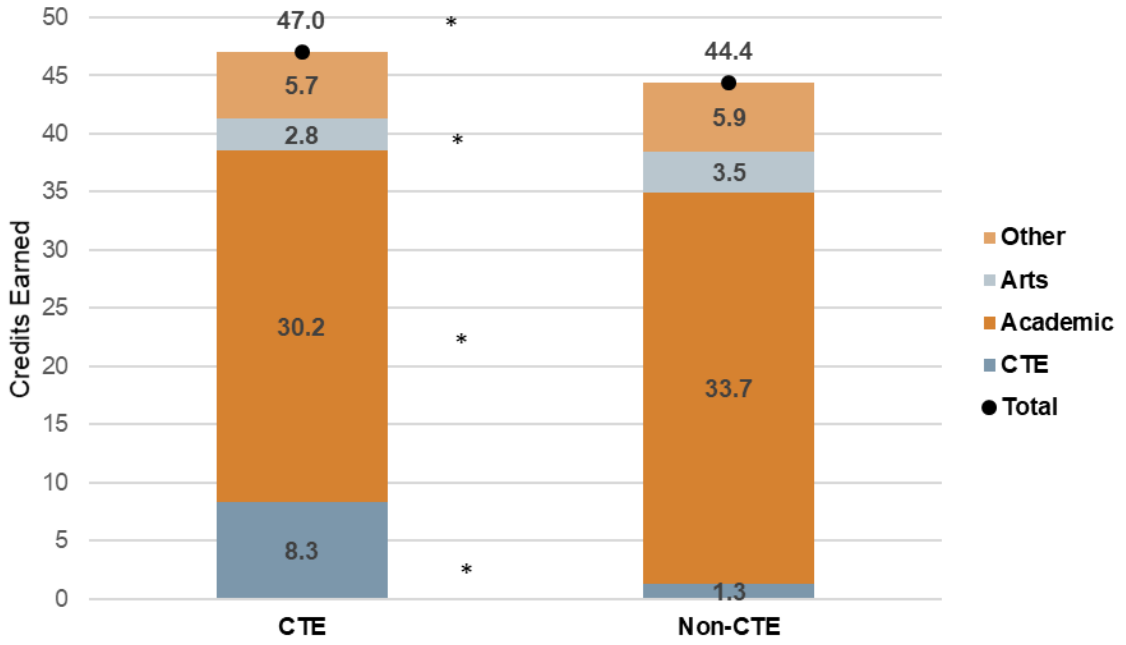
CTE Impacts on High School Outcomes

The CTE-Dedicated schools produced modest, but positive impacts on student engagement, including keeping students on track for a Regents diploma.

Although not always statistically significant from grade to grade, the CTE-Dedicated high schools produced improvements in attendance, credit accumulation, and grade point averages, and reductions in the likelihood of changing schools (detailed impact findings are available in a forthcoming working paper). Perhaps most notable was an increase of 4 to 6 percentage points in the rate at which students in Grades 9 through 11 stayed on track to graduate with a New York State Regents diploma.

One concern about CTE generally has been the idea that requiring students to complete career-specific courses and internships might distract them from other academic requirements and impede their progress through high school.[11] While we found some evidence of a tradeoff between CTE and academic coursework, it was not enough to negatively affect students' overall trajectories. As shown in Figure 1 below, CTE students earned more course credits overall compared to their non-CTE counterparts—including substantially more CTE credits. While CTE students earned somewhat fewer credits in academic subjects, they were still more likely to stay on track for a Regents diploma than their non-CTE peers.

Figure 1: Impacts of CTE-Dedicated High Schools on Credit Accumulation, by Subject Area

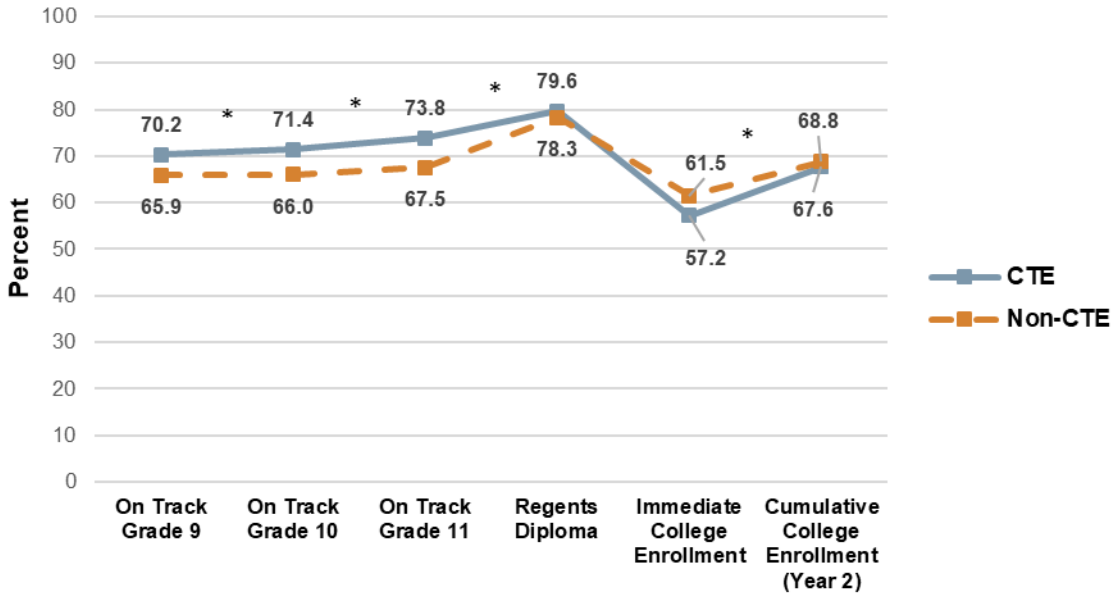


Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 20.

CTE students graduated from high school and enrolled in college at rates that were similar, on average, to their non-CTE counterparts.

As shown in Figure 2 on the next page and discussed above, the CTE-Dedicated high schools initially increased the rates at which students stayed on track for graduating with a New York State Regents diploma. By the end of Grade 12, however, the non-CTE group effectively caught up to the CTE students, and the two groups ultimately graduated at similar rates. CTE also produced a modest reduction in the rate at which students enrolled in college immediately following high school. However, this difference disappeared in the second year of follow-up, as seen on the far right side of Figure 2.[12]

Figure 2: Impacts of CTE-Dedicated High Schools on Progress Toward a Regents Diploma and College Enrollment



Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 20.

The initial difference in college going was largely driven by CTE students delaying enrollment in four-year institutions. In the Fall after their high school graduation, 39 percent of the CTE group had enrolled in a four-year college (vs. 43 percent for the non-CTE group); a year later, four-year enrollment had increased to about 45 percent for CTE students (vs. 47 percent for the non-CTE group, a difference that was not statistically significant). Rates of enrollment in two-year colleges were similar for CTE and non-CTE students throughout the follow-up period.

Variation in Impacts by Student Subgroup

CTE impacts were similar regardless of students' gender or prior achievement.

Previous research has suggested that young women are underrepresented in CTE, select different kinds of CTE programs, and have different experiences once enrolled.[13] Likewise, there has been some evidence that students' experiences in CTE may vary depending on their incoming levels of achievement and engagement.[14] In our study, while high school graduation and college enrollment rates varied dramatically across subgroups identified by gender and prior achievement, the CTE-Dedicated high schools do not appear to have produced different impacts on graduation rates for these groups. For example, more than 90 percent of the CTE students who began high school with very high test scores and attendance graduated with a Regents diploma, and 78 percent enrolled in college within three semesters following their expected graduation. The non-CTE comparison group for these students graduated from high school at nearly the same rate; their college enrollment rate was slightly higher. By contrast, just 42 percent of the CTE students who began high school with very low test scores and attendance graduated with a Regents diploma, and 28 percent enrolled in college within three semesters. The rates for their non-CTE comparison

counterparts were nearly identical. In a similar pattern, although graduation and college enrollment rates were somewhat higher for young women compared to young men, CTE-Dedicated high schools had little or no impact on these outcomes for either group.

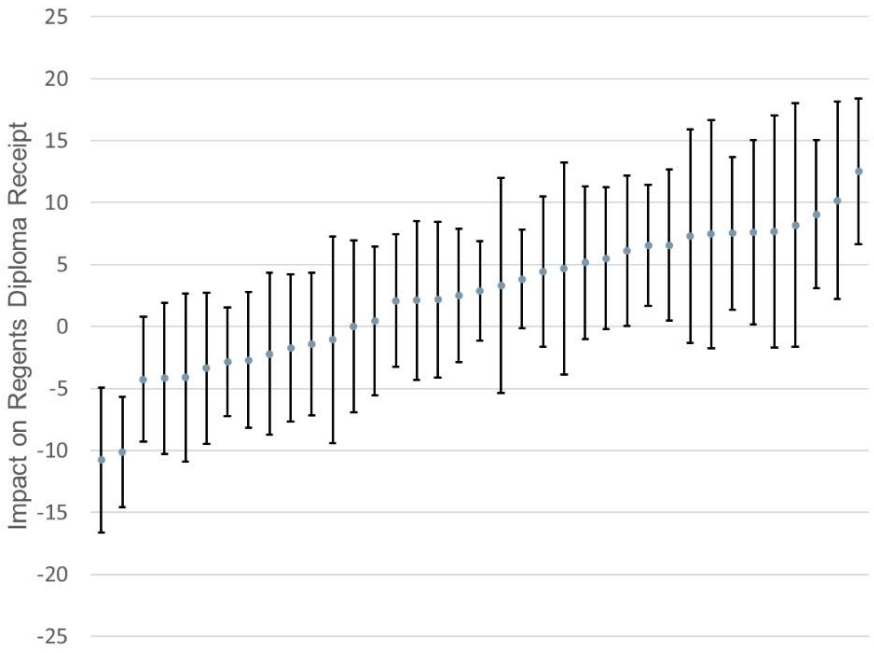
Exploring Variation in CTE Impacts Among CTE-Dedicated High Schools

Overall Variation in Impacts

The average impact on high school graduation and immediate college enrollment includes considerable variation across the 37 CTE-Dedicated high schools.

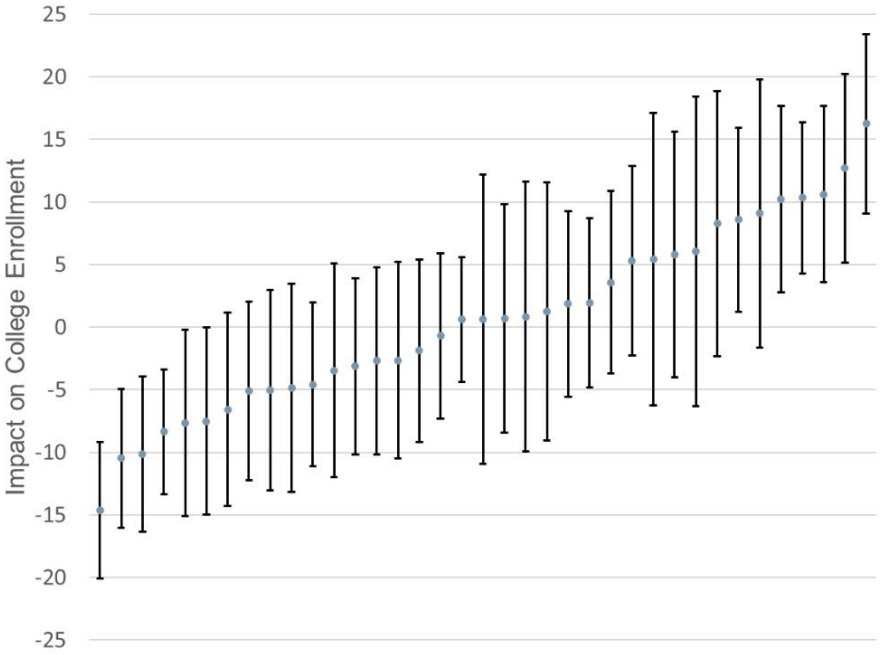
Figures 3 and 4 below show the distribution of CTE impacts on Regents diploma receipt and immediate college enrollment, respectively, for each of the 37 CTE-Dedicated high schools.[15] The figures illustrate a substantial and statistically significant level of variation across the schools. In fact, two of the schools produced a statistically significant reduction in Regents diploma receipt, and six produced reductions in immediate college enrollment. At the same time, eight schools produced statistically significant increases in Regents diploma receipt, and six produced increases in the rate at which students enrolled in college. This level of variation in impacts, as well as the substantial variation in CTE programming and careers of focus, represents a unique and potentially powerful opportunity to explore hypotheses about factors that may drive CTE effectiveness.

Figure 3: Variation in CTE Impacts on Regents Diploma Receipt, by High School



Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 21.

Figure 4: Variation in CTE Impacts on Enrollment in Four-Year Colleges, by High School



Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 21.

Exploring Variation Associated with CTE Policy and Program Conditions

There are two notable aspects of CTE policy and program conditions in NYC that provide insight into conditions under which CTE may be more or less effective at accomplishing its central goals of college and career readiness. First, 2008 marks an important inflection point in NYC's support for CTE and for high school reform in general. That year, a Mayoral Task Force issued a policy framework proposing a major expansion of CTE Programs of Study, greater clarity about core CTE programming requirements, and stronger standards for CTE quality control and support.[16] This enhanced emphasis on CTE occurred in the midst of a larger overhaul of the City's high schools that included closing persistently low-performing schools, opening new small schools in their place, and creating a universal high school admissions system that gave students access to schools across the City.

Over the next eight years, New York City added more than 25 new CTE-Dedicated high schools and reinforced the dual focus on promoting both college and career readiness. In contrast to their longstanding counterparts (some of which dated back to the early 1900s), these new high schools were smaller and offered thematically aligned sets of CTE Programs of Study. In addition, nearly all of the new CTE-Dedicated high schools did not use performance measures in their admission processes, while most of the longstanding CTE schools used test scores, grades, or other performance measures as part of their admissions criteria.

A second and related dimension of variation among the CTE-Dedicated high schools centers on their alignment with particular college and career readiness outcomes. While all CTE programs have a more explicit connection to workforce preparation compared to non-CTE instruction, they differ in terms of the careers pathways they focus on—and the extent

to which these careers require a postsecondary credential for entry-level jobs. Programs of Study preparing students for occupations that do *not* require postsecondary education may enhance opportunities to enter the labor market directly after high school, while perhaps postponing or even reducing enrollment in college. Notably, many of the newer (post-2008) high schools focused on career pathways that were likely to require a four-year degree for those seeking an entry-level job. CTE programs in the longstanding high schools focused on either work-ready career pathways or pathways aligned with occupations requiring some additional technical training or an associate degree for entry-level jobs (referred to here as "mixed" pathways).

Drawing on these insights about differing policy and program conditions, we identified five subgroups of CTE-Dedicated high schools based on the era of their creation (prior to or after 2008) and their CTE pathway orientation (described as work-ready, mixed, and college-intended).[17] See Table 3 on page 18 for more information about these five groups of schools.

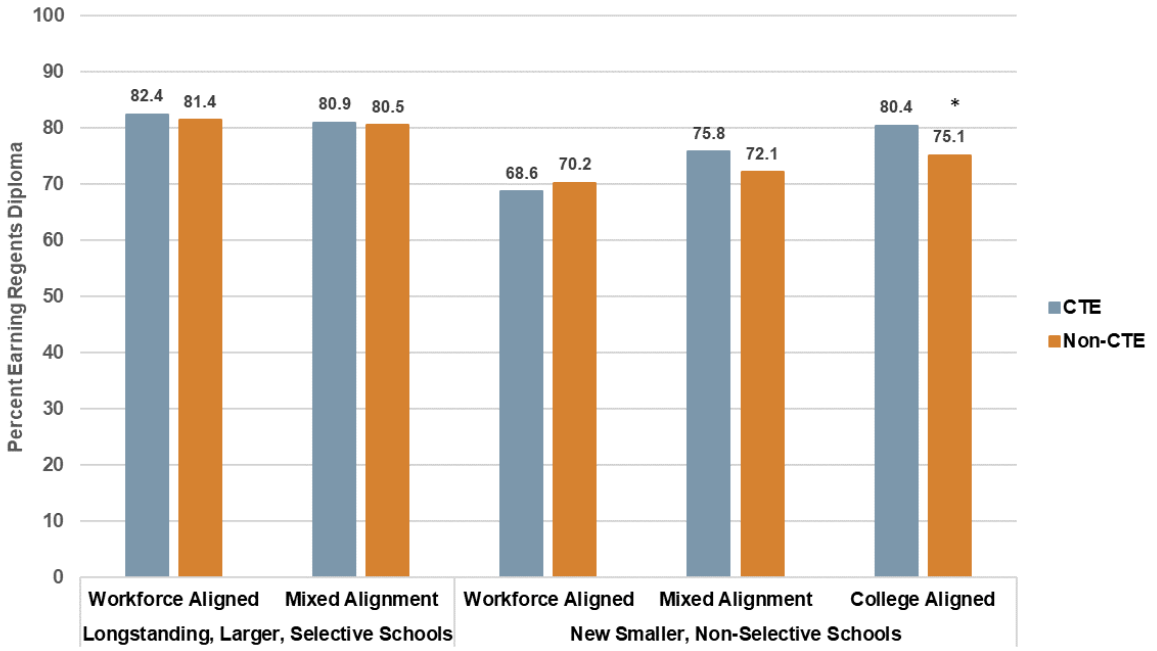
Policies favoring larger, more selective schools, with a range of CTE program themes, were associated with null or negative effects on key outcomes.

While the high school graduation and college enrollment rates for the longstanding schools were higher than those for the newer schools—a reflection of their more selective admissions criteria—these older schools had no impact on Regents diploma receipt (meaning rates for the CTE group were statistically indistinguishable from the non-CTE group—see Figure 5 on the next page). Furthermore, as shown in Figure 6, the older schools in the mixed subgroup (that is, those aligned with occupations requiring some postsecondary education) actually reduced four-year college enrollment rates by about 5 percentage points. It is important to note that we do not yet have all the information needed to make sense of this finding. Data on employment and earnings will be crucial to understanding whether students in these schools opted to enter the workforce instead of, or prior to, enrolling in college—and how these decisions affected their longer-term trajectories.

Policies promoting smaller, less selective schools with well-aligned career themes were associated with positive effects on key outcomes—particularly in programs focused on college-intended career paths.

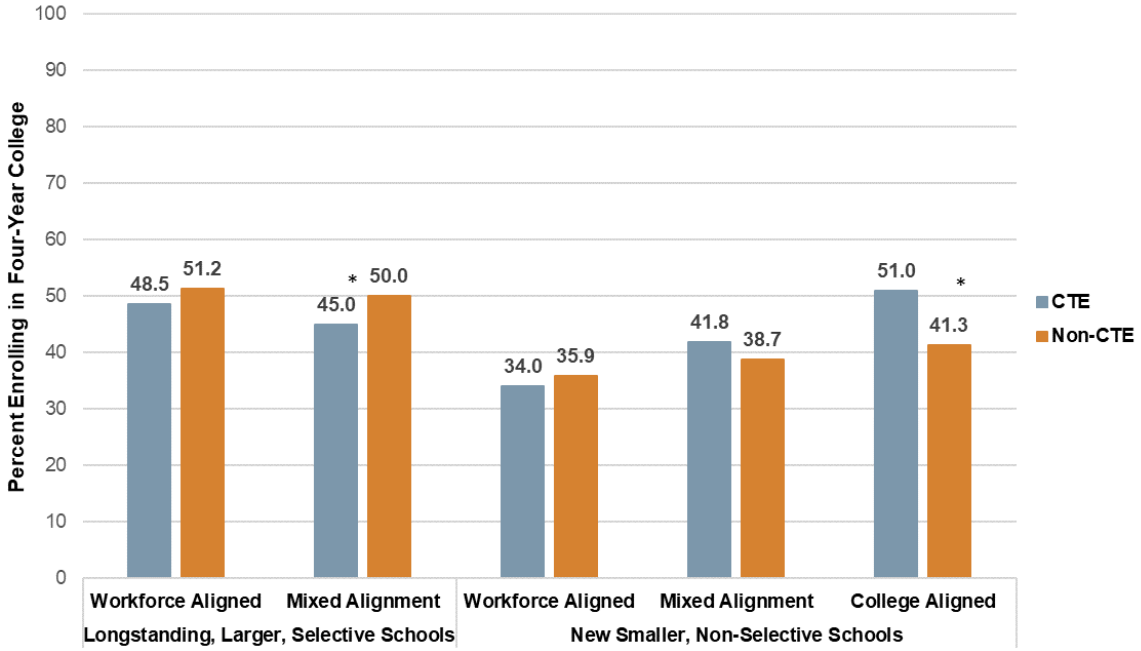
Newer schools that emphasized career paths typically requiring a bachelor's degree produced positive, statistically significant impacts on both Regents diploma receipt and immediate college enrollment. As shown in Figure 6, students in these schools were nearly 10 percentage points more likely to enroll in a four-year college than those in the non-CTE comparison group. Although not displayed in the figure, we also found that newer schools in the mixed subgroup improved enrollment in two-year colleges, without lessening four-year enrollment.

Figure 5: CTE Impacts on Regents Diploma Receipt, by High School Subgroup



Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 21.

Figure 6: CTE Impacts on Enrollment in Four-Year Colleges, by High School Subgroup



Source: Research Alliance calculations from data provided by the New York City Department of Education.
Notes: See page 21.

Discussion and Implications

The findings above include important information about the CTE program elements that were implemented in CTE-Dedicated high schools and about students' participation in CTE courses and internships. The key sources of data for this analysis are the PAF forms that CTE staff complete and student records made available by the NYCDOE. The PAF data indicate that the typical CTE-Dedicated high school provided the required number of CTE course offerings, certified teachers, and partnerships with employers and postsecondary education institutions. Most of the high schools also offered a range of work-based learning opportunities across Grades 9 through 12. The analysis of student records highlights meaningful differences in course taking and internship participation between CTE students and students who enrolled in other high schools. At the same time, our findings also indicate that some of the high schools fell well short of implementation expectations, and that substantial proportions of CTE students did not complete the expected coursework or participate in internships.

One implication of these findings is the central importance of accurate and complete data on both CTE program implementation and student participation in key CTE activities. In fact, it is not clear that the observed variation in implementation necessarily reflects real differences in CTE program "quality" even though there are distinct differences in other aspects of CTE programming. This may be a limitation of the data available in the PAF and incomplete information about student engagement in co-curricular opportunities like internships, career development programs, and other work-related learning activities.

In light of these considerations, the NYCDOE has embarked on an effort to collect and organize richer data about CTE programming and to create an integrated data system that captures student participation in a range of work-based learning activities. This is likely to support significant efforts toward continuous program improvement and will assist future research in identifying conditions under which CTE is more or less effective and for whom.

Our impact analysis shows that, on average, the CTE-Dedicated high schools produced modest improvements in a range of outcomes associated with school engagement and somewhat larger improvements in keeping students on track toward a Regents diploma by earning a sufficient number of course credits and passing Regents examinations in 9th through 12th grades. Students in the CTE-Dedicated high schools also earned substantially more CTE course credits than their non-CTE counterparts. Taken together, these findings are encouraging, as they dispel concerns that the additional CTE requirements may make it harder for students to fulfill academic requirements and progress toward graduation.

Although students in the CTE-Dedicated high schools were more likely to stay on track in 9th through 11th grades, our findings show that non-CTE students were equally likely to graduate with a Regents diploma as those in the CTE group. This appears to be due to the non-CTE students "catching up" in the 12th grade by completing their final Regents exams and credit requirements. The non-CTE group had slightly higher immediate college enrollment rates, but this difference disappeared when we followed students into the second year after their scheduled high school graduation. In truth, the postsecondary story is just beginning to emerge; more time is needed to see how college persistence and completion rates compare for the two groups of students.

While these overall averages provide useful evidence of CTE's general impact, they mask important dimensions of variation that provide insight into conditions under which CTE can be more or less effective in achieving its dual goals of college and career readiness. Above, we highlighted important aspects of the CTE policy and program contexts that shaped the schools' organizational structures and target populations, as well as their orientation toward college and career readiness goals. One set of CTE-Dedicated high schools—those newly opened in an era of dramatic high school reform and CTE expansion—reflect open, non-selective admissions and smaller, more personalized learning environments.[18] In contrast, another set of high schools continued the tradition of serving larger numbers of students, offering a wider range of career themes, and relying on student achievement and performance as admissions criteria.

The CTE-Dedicated high schools also varied in the career and occupational pathways they focused on and the credentials typically required for entry-level employment in those occupations. We were able to identify schools with college-intended programs focused on occupations that typically require a bachelor's degree, and schools with work-ready programs focused on occupations that may offer employment immediately after high school. We also identified schools whose CTE programs were aligned with occupations likely to require some additional training or an associate degree for an entry-level job.

We found that students in the larger, more selective CTE-Dedicated high schools had graduation and college enrollment rates that were similar or slightly lower than their non-CTE counterparts. Looking beyond the data currently available, it will be important to determine whether the lower rates of immediate college enrollment are an artifact of CTE enabling some students to gain access to productive employment before making the financial commitment to college.

In contrast, the smaller, non-selective high schools with college-intended CTE programs produced meaningful improvements in high school graduation rates and substantial increases in enrollment in four-year colleges. These findings suggest that when policies promote smaller, less selective schools, with more tightly aligned themes and a stronger focus on college pathways, CTE programs can effectively engage students in career-relevant learning experiences while boosting their odds of graduating from high school and transitioning to college.

Open Questions and Next Steps

As noted previously, CTE Programs of Study are also offered as one of several options available to students in Comprehensive high schools that are not fully dedicated to CTE. Given the availability of multiple options within these schools, it is likely that the patterns of student completion of CTE courses and participation in work-based learning activities are different from those in CTE-Dedicated high schools. Thus, our study will turn next to an assessment of the implementation and impact of the CTE programs offered in Comprehensive high schools, including a look at the same program elements, student experiences, and student outcomes that we examined for this report.

Another important set of open questions revolves around CTE's costs. As part of the larger study, we are conducting an analysis of the costs associated with CTE and the degree to which these costs may differ from those of high schools that do not offer CTE programs.

This work will provide further information about CTE implementation and additional context for assessing the relative benefits of CTE for students.

Finally, there are crucial open questions about the longer-term impacts of CTE programs. The study team is working closely with the NYCDOE to obtain additional follow-up data that can shed light on students' persistence in college and completion of postsecondary credentials. Importantly, the NYCDOE is also committed to obtaining data on postsecondary employment and earnings in an effort to assess CTE's impacts on labor market participation, in addition to college enrollment. This information will provide a much more complete picture of the role that New York City's CTE programs are playing in preparing students for the future.

Additional Information

Data Sources and Methods Used for this Study

This study has benefited from an extraordinary assembly of data from multiple sources and multiple levels of analysis. In addition to individual-level data on a variety of student experiences and outcomes, the study incorporated detailed and nuanced information about CTE Program of Study characteristics that are captured by Program Accountability Forms (PAFs) and other sources provided by the NYCDOE's CTE office.

For the purposes of this study, we created measures of CTE Program of Study features using available administrative data and a novel data set that we created by scraping elements from standardized PAFs. High Schools are required to submit PAFs on an annual or bi-annual basis for accountability purposes and to be considered for state program approval or renewal of that approval (every five years). However, because PAFs contain information that is self-reported by schools to NYCDOE, and oversight of PAFs was not consistent year-to-year, we do not have full coverage of PAF data across schools and years. In all, 88 of the 106 Programs of Study in CTE-Dedicated high schools submitted at least one PAF during the time period of focus. Further, 35 of the 37 CTE-Dedicated high schools have PAF data from at least one Program of Study. The remaining high schools each operated one Program of Study during the sample period, but did not submit any PAF forms that could be scraped by the research team.

In an effort to assess the validity and reliability of the available PAF data, we conducted an assessment of our measures using NYCDOE staff's independent rating of CTE program characteristics based on their direct knowledge of selected high schools. This assessment yielded a high degree of consistency between the school-reported PAF data and the NYCDOE staff ratings of CTE Program of Study characteristics.

Using the PAF data, we calculated the number of teachers, credits, and employer and college partners, and the number and type of work-based learning activities available to students for each program, as well as a list of industry certifications that were made available to students. Separate NYCDOE data sources provided us with the number of programs in each school, and the number of students enrolled per program. Indicators for whether a program has been approved by the state were also available and have been included in Table 3 below.

The research design for the CTE impact study compares the experiences and outcomes of students who were assigned to a CTE-Dedicated high school as part of the NYCDOE High School Application Processing System (HSAPS) with outcomes of similar students who applied for admission to these high schools but were assigned to other, non-CTE high schools that they included on their list of preferences. The primary anchor for the impact analysis is a distinctly rigorous application of propensity score matching (PSM) methods. In addition to information about students' high school preferences, the PSM approach draws on an array of rich longitudinal student-level background characteristics and prior school experiences and outcomes. This information was used to construct matching models that identified a group of non-CTE students who were statistically similar to the students who were selected for the CTE-Dedicated high schools.

The PSM design was validated against naturally occurring randomized controlled trials (RCTs) that took place for a subset of the CTE-Dedicated high schools during the study

period. The RCTs grow out of the HSAPS process and provide internally valid and reliable estimates of CTE impacts on student outcomes during high school and beyond. (Results from the RCT design and sample are presented in a separate document.) Although the results generated by this RCT sample are internally valid from a research design perspective, the sample represents less than 20 percent of all students assigned to the CTE-Dedicated high schools during this period. Our validation analyses produced both baseline equivalence for the overlapping PSM sample and impact estimates for the PSM sample that were nearly identical to the RCT-based results.

This research design maximizes both the internal validity and reliability of differences in outcomes between the CTE and non-CTE groups as reflecting causal effects of CTE. It also maximizes the generalizability of the findings to the full population of 37 CTE-Dedicated high schools.

The study design accounts for the fact that students who are attracted to CTE high schools differ from the general population of NYCDOE students on a wide range of measured and unmeasured characteristics. However, when comparing CTE students with students who had similar achievement levels and other characteristics during middle school, we find much smaller differences between the groups during high school. By accounting for preexisting differences, the study allows us to understand the distinct impact of being assigned a CTE-Dedicated high school on students' outcomes.

Table 2: Characteristics of Students Assigned to New York City High Schools, 2013-2016, by High School Type

		Assigned to CTE		Not Assigned to CTE	
	All High Schools	CTE-Dedicated High Schools	Comprehensive High Schools with CTE	Comprehensive High Schools with CTE	Other High Schools
Demographic Characteristics (%)					
Gender					
Female	47.0	37.6	46.1	47.7	49.4
Male	53.0	62.5	53.9	52.3	50.6
Race/Ethnicity					
Asian	15.0	12.1	18.0	23.0	11.9
Black	26.3	31.7	20.6	22.2	29.0
Latinx	38.0	42.7	34.6	28.4	41.4
White	14.0	6.7	20.0	19.5	11.1
Other	6.7	6.8	6.8	7.0	6.6
Home Language					
English	59.0	61.9	55.5	56.4	60.8
Not English	41.0	38.1	44.5	43.6	39.2
Socio Economic Status					
No Poverty Indicators	31.6	28.0	33.4	34.7	30.6
One or More Poverty Indicators	68.4	72.0	66.6	65.3	69.4
Grade 8 Academic Characteristics (%)					
Enrollment Status					
NYCDOE School	94.1	94.4	93.8	93.8	94.2
Private School	6.0	5.6	6.2	6.2	5.8
Attendance					
Attendance	92.9	92.8	93.0	93.4	92.8
Chronic Absentee	18.3	18.3	18.0	16.6	18.9
English Language Learning Services					
Not a Recipient	89.5	91.7	88.9	90.6	89.0
Recipient	10.5	8.3	11.1	9.4	11.1
Special Education Services					
Not a Recipient	82.3	80.5	82.3	84.1	82.2
Recipient	17.7	19.6	17.7	15.9	17.8
State Test Score Proficiency					
English Language Arts					
Levels 1-2	63.8	68.5	64.4	56.9	64.6
Levels 3-4	36.2	31.5	35.6	43.1	35.4
Math					
Levels 1-2	74.5	78.1	73.9	66.2	76.4
Levels 3-4	25.5	21.9	26.1	33.8	23.6
Schools	433	47	88	88	298
Students	342,783	39,281	80,645	52,293	170,564

Table 3: CTE-Dedicated High School Subgroups by Selected Policy and Program Characteristics

	Longstanding Schools (Pre-2008)		*New Schools (Post-2008)*		
	Work-Ready Aligned	**Mixed Alignment**	**Work-Ready Aligned**	**Mixed Alignment**	**College Aligned**
Overall Description	*Larger high schools using selective admissions. Range of career themes generally aligned with preparation for direct workforce entry.*	*Larger high schools using selective admissions. Range of career themes aligned with occupations requiring some postsecondary education for workforce entry.*	*Smaller high schools using nonselective admissions. Coherent set of career themes more aligned with preparation for direct workforce entry.*	*Smaller high schools using nonselective admissions. Coherent set of career themes aligned with occupations requiring some postsecondary education for workforce entry.*	*Smaller high schools using nonselective admissions. Coherent set of career themes aligned with occupations requiring four-year college degrees for workforce entry.*
Admissions Selectivity	78% screened or education options admissions; enrolled students scored just below the City average on middle school state tests.	75% screened or education options admissions; enrolled students scored just below the City average on middle school state tests.	97% limited unscreened admissions; enrolled students scored below the City average on middle school state tests.	86% limited unscreened admissions; enrolled students scored below the City average on middle school state tests.	97% limited unscreened admissions; enrolled students scored below the City average on middle school state tests.
Postsecondary Career Pathways	Pathways aligned with entry-level jobs requiring high school diploma and some training.	Pathways aligned with entry-level jobs requiring technical training / certification or an associate degree.	Pathways aligned with entry-level jobs requiring a high school diploma and some training.	Pathways aligned with entry-level jobs requiring technical training / certification or an associate degree.	Pathways aligned with entry-level jobs requiring a bachelor's degree or higher.
Size (Entering 9th Grade Enrollment)	242	228	116	96	108
Demographics	9% Asian, 50% Black, 35% Latinx, 5% White; 31% girls; above-average share of students from lower-income households.	12% Asian, 36% Black, 45% Latinx, 6% White; 34% girls; above-average share of students from lower-income households.	4% Asian, 49% Black, 41% Latinx, 4% White; 44% girls; above-average share of students from lower-income households.	4% Asian, 31% Black, 59% Latinx, 4% White; 33% girls; above-average share of students from lower-income households.	10% Asian, 41% Black, 41% Latinx, 6% White; 41% girls; below-average share of students from lower-income households.
Average # of Programs of Study	3	4.5	2	2.6	1.4
Career Focus	IT (33%) Transportation (20%) Hospitality (20%) Construction (13%)	IT (22%) Manufacturing (16%) Health Services (16%) Construction (12%) Transportation (12%)	Construction (45%) Health Services (27%) Manufacturing (9%) STEM (9%) Agriculture & NR (9%)	IT (35%) Agriculture & Natural Resources (18%) Transportation (18%) Law and Safety (6%) STEM (6%)	IT (54%) Health Services (23%) Business (15%) Arts (7%)
Partners	About 2 industry partners and 1 postsecondary partner	About 2 industry partners and 1 postsecondary partner	About 1 industry partner, and 1 postsecondary partner (or less)	About 2 industry partners, and 1 postsecondary partner	More than 4 industry partners, and nearly 2 postsecondary partners
State Approval	80%	82%	54%	65%	39%

Endnotes

[1] For a discussion of opportunities to learn from NYC's CTE initiatives, see Jacoby, T. and S. Dougherty (2013). *The New CTE: New York City as a Laboratory for America.* New York, NY: Manhattan Institute for Policy Research. https://media4.manhattan-institute.org/sites/default/files/R-TJSD-0316.pdf

[2] See, for example, the Career Readiness and Modern Youth Apprenticeship (CRMYA) program announced in September 2022.

[3] Remarks from NYC Schools Chancellor David Banks, 3/2/2022. Accessed on 8/8/2022 from: https://www.schools.nyc.gov/about-us/news/announcements/contentdetails/2022/03/02/chancellor-banks-outlines-vision-for-transforming-and-building-trust-in-nyc-public-schools

[4] CTE Programs of Study that provide consistent documentation of these elements receive certification from the New York State Education Department (NYSED) and NYCDOE. As discussed in the textbox on page 2, in addition to the CTE-Dedicated schools that are the focus this report, CTE Programs of Study are also offered in some of NYC's Comprehensive high schools. While the programmatic elements are intended to be the same, the dynamics of student enrollment and engagement in CTE-related courses and activities can be quite different in CTE-Dedicated versus Comprehensive high schools. A subsequent report from this study will focus on the implementation and impact of CTE programs in the Comprehensive high school context.

[5] The sample for this report does not include high schools that were implementing the PTECH model, which is being examined under a separate, related study. See Dixon M., and R. Rosen (2022). *On Ramp to College: Dual Enrollment Impacts from New York City's P-TECH 9-14 High Schools.* New York, NY: MDRC. https://www.mdrc.org/publication/ramp-college

Because it was not possible to identify a valid comparison group, the sample also does not include CTE-Dedicated high schools that used performance auditions as part of their admissions process. The student sample for this report does not include students who attended private middle schools because of missing middle school background information. Finally, the sample does not include students requiring certain special education services and who were assigned to high schools through a separate admissions process.

[6] See http://www.nysed.gov/career-technical-education/technical-endorsement (accessed on 12/7/2022) for a detailed description of NYSED CTE Program requirements.

[7] The PAF data were validated against NYCDOE staff's independent assessment of CTE program characteristics indicating that they appear to provide a generally reliable picture of the CTE program elements being offered to students. While the PAF data are extremely rich and cover most of the CTE landscape in NYC, we recognize that some CTE programs do not submit PAFs and, for those that do, some information on the PAFs may be incomplete. In addition, although we make use of all the PAF data available to us, these data may not accurately reflect all of the changes that have occurred in the CTE programs during the period covered by the study. See page 15 for more information about the PAF data.

[8] To receive CTE program approval, schools must provide evidence of a CTE course sequence and curriculum matched to state standards, identification of a technical assessment for each program area, an articulation agreement with an institution of higher education, and work-based learning experiences for students. Approved programs are eligible for additional state and federal funding. Students who enroll in NYSED-approved CTE programs and successfully complete all requirements earn a CTE technical endorsement that accompanies their high school diploma. Finally, because the approval process includes demanding reporting requirements and may take years to complete, some CTE programs do not apply and others are not approved. For more information about NYSED CTE Approval and Technical endorsement see http://www.nysed.gov/career-technical-education/technical-endorsement (accessed 12/7/2022).

[9] In NYC, students earn one credit per semester course or two credits for a year-long course. NYSED requires a minimum of four CTE credits for a CTE-certified diploma. Under the most recent version of the Carl Perkins Act, students are required to complete two full-year CTE credits for federal reporting purposes (the previous version of the Act required three full-year credits).

[10] See Jacoby, T. and Dougherty, S (2013) cited in endnote 1 for a discussion of these challenges in NYC.

[11] Academic subjects include Math, English, Social Studies, Science, and World Languages. Prior research has examined the consequences of reductions in academic course credits among CTE students. See Bozick, R., and B. Dalton (2013). "Balancing career and technical education with academic coursework: The consequences for mathematics achievement in high school." *Educational Evaluation and Policy Analysis*, 35(2), 123-138. https://journals.sagepub.com/doi/10.3102/0162373712453870

[12] Compared to citywide averages during this period, students in the CTE group achieved somewhat higher graduation rates and somewhat lower college enrollment rates overall. However, our analyses show that these differences are likely due to the selection or self-selection of certain students into the CTE-Dedicated high schools and do not necessarily reflect the impact of having enrolled in those high schools. When examining outcomes through the lens of the more valid and reliable research design used in this study, relying on a suitable comparison group of non-CTE students, we find little or no difference, on average, between the CTE group and non-CTE group in their Regents diploma and college enrollment rates.

[13] See, for example, Kemple, J., S. Corcoran and J. Sludden (2020). "Who Chooses Career and Technical Education in NYC?" Spotlight on NYC Schools. New York, NY: The Research Alliance for New York City

Schools. Also see, Dougherty, S. and I. Macdonald. (2020) "Can growth in the availability of STEM technical education improve equality in participation? Evidence from Massachusetts." *Journal of Vocational Education & Training* 72.1, 47-70.

[14] See Kemple, J. and C. Willner (2008). *Career Academies: Long-Term Impacts on Labor Market Outcomes, Educational Attainment, and Transitions to Adulthood.* New York, NY: MDRC. See also Brunner, E., S. Dougherty, and S. Ross (2021). "The Effects of Career and Technical Education: Evidence from the Connecticut Technical High School System." *Review of Economics and Statistics*, 1-46. https://doi.org/10.1162/rest_a_01098

[15] The figures present "Empirical Bayes Shrinkage" estimates, which avoid overestimating the level of variation by accounting for different sample sizes and outcome variability across schools.

[16] Mayoral Task Force on Career and Technical Education (2009). *Next Generation Career and Technical Education in New York City: Final Report and Recommendations of the Mayoral Task Force on Career and Technical Education.* Accessed 12/9/22 from: https://nyctecenter.org/images/ctelibrary/files/staff_resources/cte_future_directions/Mayors%20Report%20%20CTE-%20Final.pdf

[17] A full description of the specification of these subgroups can be found in Chapter 3 of the forthcoming working paper. That chapter includes a discussion of analyses indicating substantial variation within and across the subgroups in terms of CTE course offerings and completions, certified teachers, work-based learning activities, partnerships with employers and post-secondary institutions, and internship participation. In general, even though the subgroups varied widely in terms of their implementation of key CTE program components, their distinctive policy and pathway orientations were associated with quite different patterns of impacts.

[18] Prior research on NYC's Small Schools of Choice provides strong evidence of their substantial and persistent impact on students' progress through high school and transitions to postsecondary education. See, for example, Bloom and Unterman (2013). *Sustained Progress: New Findings About the Effectiveness and Operation of Small Public High Schools of Choice in New York City.* New York: MDRC. https://www.mdrc.org/publication/sustained-progress

Table and Figure Notes

Table 1: Impacts of CTE-Dedicated High Schools on Students' Exposure to CTE Programming

The CTE Group sample includes students who were assigned to a CTE-Dedicated high school through NYC's High School Application Processing System (HSAPS) and did not transfer out of the NYCDOE prior to their 12th grade year. CTE Group outcomes were calculated as the unadjusted average for the CTE Group sample.

The Control Group sample includes students who applied to a CTE-Dedicated high school but were assigned to a non-CTE program as part of the HSAPS process and did not transfer out of the NYCDOE prior to their 12th grade year. CTE Group outcomes were calculated as the difference between the CTE Group average and the Impact Estimate.

Impacts were calculated as the estimated difference between the CTE and Control groups. Impact estimates were regression adjusted to account for residual differences by race/ethnicity, gender, 8th grade attendance, 8th grade ELA and math test scores, and English Language learning and special education statuses. Impact estimates were also adjusted to account for residual differences within the HSAPS assignment groups within and across school years. Standard errors and p-values of impact estimates account for clustering of students within high schools, HSAPS programs, and school years.

Statistical significance of impact estimates is indicated by * = p-value ≤ 0.05.

Measures of credits for CTE courses, college courses, and internships are based on data from the NYCDOE STARS data system. Students earn one credit per semester and two credits for a full year course.

Measures of participation in paid internships are based on data from the NYCDOE Internship Management Information System.

Figure 1: Impacts of CTE-Dedicated High Schools on Credit Accumulation by Subject Area

For information about impact estimation, see notes for Table 1 above.

Figure 2: Impacts of CTE-Dedicated High Schools on Progress Toward a Regents Diploma and College Enrollment

On-track in Grade 9 includes earning 11 or more course credits and passing one or more NYS Regents examination. On-track in Grade 10 includes earning 22 or more course credits and passing two or more NYS Regents examinations. On-track in Grade 11 includes earning 33 or more course credits and passing three or more NYS Regents examinations.

Measures of college enrollment are based on data from the National Student Clearinghouse provided by the NYCDOE and from administrative records provided by the City University of New York.

For information about impact estimation, see Notes for Table 1.

Figure 3: Variation in CTE Impacts on Regents Diploma Receipt by High School and

Figure 4: Variation in CTE Impacts on Enrollment in Four-Year Colleges by High School

Impact estimates for each school are presented in the figures as Empirical Bayes Shrinkage (EBS) estimates. EBS estimates avoid overestimating the level of variation by accounting for different sample sizes and outcome variability across schools. Bars in the figures represent 95% confidence intervals for the school-specific impact estimates.

College enrollment rates are calculated as having enrolled in a four-year college any time within three semesters of scheduled high school graduation.

For information about impact estimation, see notes for Table 1.

Correction note: The figures have been updated from a previous version to reflect correct confidence intervals.

Figure 5: CTE Impacts on Regents Diploma Receipt by High School Subgroup and

Figure 6: CTE Impacts on Enrollment in Four-Year Colleges by High School Subgroup

For more information about the high school subgroups, see Table 3.

College enrollment rates are calculated as having enrolled in a four-year college any time within three semesters of scheduled high school graduation.

For information about impact estimation, see notes for Table 1.

Table 2: Characteristics of Students Assigned to New York City High Schools, 2013-2016, by High School Type

Source: Research Alliance calculations from data provided by the New York City Department of Education.

For information about the distinction between CTE-Dedicated and Comprehensive high schools, see the text box on page 2.

Race/ethnicity categories are self-reported by parents or guardians when they enroll their child in a NYCDOE school. Latinx includes all students who were reported as “Hispanic” regardless of their reported race.

Poverty indicators include eligibility for free or reduced price lunch or for Transitional Assistance for Needy Families (TANF).

Chronic absenteeism is defined as an annual attendance rate of less than 90 percent.

Levels 1 and 2 on New York State Math and English Language Arts assessments are considered to be below state standards for proficiency. Levels 3 and 4 are considered to be proficient and advanced proficient, respectively.

Table 3: CTE-Dedicated High School Subgroups by Selected Policy and Program Characteristics

Source: Research Alliance calculations from data provided by the New York City Department of Education.

Information about school size and demographics are based on administrative data provided by the NYCDOE.

Information about CTE Programs of Study, Career Focus, Partnerships with Industry and Post-Secondary Institutions, and State Approval are based on data from NYCDOE CTE Performance Accountability Forms (PAFs).

Information about selectivity is based on NYCDOE HSAPS data.

Information about Postsecondary Career Pathways are based on links constructed by the Research Alliance between CTE Curricular Instruction Program (CIP) codes provided by the NYCDOE and US Department of Labor (USDOL) Standard Occupational Classification (SOC) system codes. USDOL provides a “job zone” score for each SOC code based on the level of education typically required for an entry-level job. Job zone scores range from 1 to 5 with 1 indicating a high school diploma or less and 5 indicating a four-year college degree or higher.

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