P-TECH 9-14 Pathways to Success

Implementation, Impact, and Cost Findings from the New York City P-TECH 9-14 Schools Evaluation

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October 2023

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TO IMPROVE SOCIAL POLICY

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FUNDERS

This study is being supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A170250 to MDRC. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education. Before receiving funding from the Institute of Education Sciences, MDRC conducted early work on P-TECH 9-14 with funding from the Carnegie Corporation of New York. MDRC's Center for Effective Career and Technical Education receives support for dissemination efforts from Carnegie Corporation of New York and Bloomberg Philanthropies.

Dissemination of MDRC publications is supported by the following organizations and individuals that help finance MDRC's public policy outreach and expanding efforts to communicate the results and implications of our work to policymakers, practitioners, and others: The Annie E. Casey Foundation, Arnold Ventures, Charles and Lynn Schusterman Family Foundation, The Edna McConnell Clark Foundation, Ford Foundation, The George Gund Foundation, Daniel and Corinne Goldman, The Harry and Jeanette Weinberg Foundation, Inc., The JPB Foundation, The Joyce Foundation, The Kresge Foundation, and Sandler Foundation.

In addition, earnings from the MDRC Endowment help sustain our dissemination efforts. Contributors to the MDRC Endowment include Alcoa Foundation, The Ambrose Monell Foundation, Anheuser-Busch Foundation, Bristol-Myers Squibb Foundation, Charles Stewart Mott Foundation, Ford Foundation, The George Gund Foundation, The Grable Foundation, The Lizabeth and Frank Newman Charitable Foundation, The New York Times Company Foundation, Jan Nicholson, Paul H. O'Neill Charitable Foundation, John S. Reed, Sandler Foundation, and The Stupski Family Fund, as well as other individual contributors.

The findings and conclusions in this report do not necessarily represent the official positions or policies of the funders.

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OVERVIEW

The New York City P-TECH 9-14 schools are an educational model that ties together the secondary, higher education, and workforce systems to improve outcomes across domains. The distinguishing feature of the model is a partnership among a high school, a community college, and one or more employer partners that focuses on preparing students for both college and careers within six years.

P-TECH 9-14 schools collaborate with local colleges to provide students with an opportunity to earn a high school diploma within four years, followed by a cost-free, industry-recognized associate's degree. During the six-year program, employer partners provide students with work-based learning experiences such as internships, mentoring, and job shadowing. This model has proliferated rapidly both nationally and internationally since the first school was opened in Brooklyn, NY in 2010.

This study provides impact, implementation, and cost study findings from the first rigorous evaluation of the model, examining the first seven P-TECH 9-14 schools that opened in New York City. The study follows entering classes of students for seven years after they begin ninth grade, which would carry them through the end of their expected high school graduations and through three years of postsecondary education. The study takes advantage of the random lottery process created by the New York City high school admissions system to identify the model's effects: It compares students who won lotteries to attend P-TECH 9-14 schools (the P-TECH 9-14 group) with students who applied but did not win (the comparison group). It also includes an in-depth implementation study that assesses how schools carried out the model, and a cost-effectiveness study that examines costs per college degree earned for P-TECH 9-14 schools compared with other schools.

Findings

1. The high school, career, and college elements of the P-TECH 9-14 model were implemented at all schools, though there was also variation across the schools in the opportunities they had available and how they implemented specific elements of the model. Graduating with an associate's degree from the affiliated college is just one of many potential postsecondary options that school staff members may advise a student to take.
2. Students in the P-TECH 9-14 group were 38 percentage points more likely to have had an internship during four years of high school than students in the comparison group.
3. After four years of high school, 46 percent of students in the P-TECH 9-14 group had dual enrolled in at least one college-level course, compared with 20 percent of students in the comparison group.
4. Seven years after entering high school, students in the P-TECH 9-14 group were 5 percentage points more likely to have completed an associate's degree. These impacts primarily reflect results among young men: 13 percent of young men in the P-TECH 9-14 group completed an associate's degree, compared with 3 percent of young men in the comparison group.
5. The cost analysis shows that PTECH 9-14 schools can generally be operated with resources that are not significantly different than other high schools in the community. Postsecondary costs were higher for the P-TECH 9-14 group, as would be expected given the model's focus on earning a college degree. The findings about the model's cost-effectiveness in producing postsecondary degrees at six years are inconclusive. Additional cost analyses over longer periods are needed.

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ACKNOWLEDGMENTS

This report represents the culmination of more than six years of research conducted by the P-TECH 9-14 study team. It has involved collaboration with multiple partners and engaged stakeholders as well as the support of many additional MDRC staff members, and would not have been possible without them.

Special gratitude is offered to the staffs of the New York City Public Schools (NYCPS) Office of Postsecondary Readiness and the City University of New York (CUNY) Early College Initiative. All have collaborated with us with a spirit of openness, answering multiple questions, providing information, and supporting the development of ongoing research relationships with the schools in the study.

We particularly want to thank Reina Utsunomiya and Raisa Schwanbeck of NYCPS and Rodrigo Ramirez of CUNY for collaborating with us since the beginning of this project. Birunda Chelliah and Vivian Liu of the CUNY Office of Research, Evaluation and Program Support helped facilitate access to CUNY data and records. James Kemple of the Research Alliance for New York City Schools provided us with access and support for use of that organization's longitudinal data files used for analysis, as well as valuable research perspective and comments.

The principals of the seven P-TECH 9-14 schools—Hope Barter, Kristin Cahill, Rashid Davis, Patrice Henry, Sarah Kaplan, April McKoy, and Samona Tait—have been patient with our requests and open to our visits and inquiries. We also thank the schools' staff members for their eagerness to share their experiences with us and willingness to open their doors and welcome us into their schools. Staff members from the schools' industry sponsors also provided us with valuable information, and were generous with their time and support for this work.

The P-TECH 9-14 study is one of the member projects in the Career and Technical Education Research Network, also funded by the federal Institute of Education Sciences, and we have benefited from valuable suggestions from the other researchers in this network.

Rob Shand provided invaluable collaboration, ideas, and comments on the cost study.

Finally, multiple MDRC staff members outside of the core project team provided essential comments, insights, and review. In particular, Rebecca Unterman provided exceptional review and technical support for the data and methodological portions of this study. William Corrin, John Hutchins, Sue Scrivener, and Alyssa Ratledge also provided thoughtful and creative suggestions. Sonia Drohojowska provided excellent resource management and Crystal Byndloss provided thoughtful leadership early in the project. Leslyn Hall and Bulent Can provided survey advice and support. Joshua Malbin provided editorial support and advice. Lauren Lee, Sophia Otasowie, Fernando Medina, Melissa Gelin, and Reuben Perez also provided valuable research assistance during various phases of this project.

The Authors

EXECUTIVE SUMMARY

The first P-TECH 9-14 school opened in Brooklyn, NY, in 2010. A collaboration among New York City Public Schools (NYCPS), the City University of New York (CUNY), and IBM, the school was a six-year high school, allowing students to earn both a high school diploma and a free applied associate's degree in a science, technology, engineering, or math (STEM) field at a partner CUNY campus simultaneously. IBM, the schools' employer partner, provided internships and other work-based learning experiences for students, and the two associate's degrees students could earn were in fields related to the work of IBM. Students who completed degrees were also first in line for entry-level jobs at IBM.

Since the first school opened, New York City has opened a total of nine P-TECH 9-14 schools that enroll students from grade 9 through two years of postsecondary education. All these schools involve a three-way partnership among a high school, a community college, and an employer partner. While each of these schools is somewhat different, the basic elements of the model are the same, where each school has one or more employer partners and offers one or more college degrees at the affiliated community college in fields related to the work of the industry partner, creating a pipeline of talent into specific, high-demand industries. Students participate in career and technical education (CTE), work-based learning opportunities, and college classes (including college classes taken while students are in high school, or *dual-enrollment* courses) during the six-year program. The first seven of these schools have taken part in an evaluation conducted by MDRC and funded by the U.S. Department of Education's Institute of Education Sciences

This evaluation provides the first rigorous evidence about the effects of the P-TECH 9-14 model on student outcomes. The study uses a lottery-based random assignment design that takes advantage of the nature of the New York City high school admissions process, in which students were randomly offered or not offered an opportunity to attend a P-TECH 9-14 school. This analysis makes possible a comparison of outcomes where differences between groups of students can be attributed to the difference in the opportunity to attend the schools rather than to other factors, such as student motivation or other characteristics.

This study has also investigated how P-TECH 9-14 schools implemented the elements of the model, and where implementation varied among schools, and has conducted a cost and cost-effectiveness analysis, which assesses the impacts relative to the cost of obtaining them.

MODEL IMPLEMENTATION

The implementation study found that all P-TECH 9-14 schools do maintain a dual focus on college and career, with all study schools providing opportunities for students to engage in college classes, career exploration, and work-based learning activities. Notably, though, graduating with the associate's degree offered at the affiliated community college as part of a school's model is not the primary goal at most P-TECH 9-14 schools and is just one of many potential postsecondary options. Only a minority of school leaders felt that it was the mission of the school to have as many students as possible remain to pursue the affiliated degree. Rather, school leaders acknowledged that students have a wide variety of interests, often beyond the school's CTE pathways, and their definitions of success centered on ensuring that all students develop a wide range of skills in order to prepare them for the postsecondary options of their choice.

Additionally, while all schools implement the three main components of the model, not all P-TECH 9-14 students are able to participate in every college and career activity available at each school. Factors that influence variation in students' experiences include schools' relationships with their college and employer partners, requirements for participation in college and career activities, and student interest. The P-TECH 9-14 model requires substantial coordination and relationship management across high school, employer, and college partners. Relationships with employer partners vary based on what the employers are able to provide to the schools and relationships with college partners can vary based on colleges' abilities to meet high school students' needs. Other factors include grade point average requirements to participate in some work-based learning activities, and the screening of students for internship eligibility. Finally, not all students remain interested in the pathways provided by the schools, and may choose not to participate.

Finally, the COVID-19 pandemic affected implementation of the components of the P-TECH 9-14 model as all NYCPS schools moved to a virtual format in March 2020, and continued in a hybrid model during the 2020-2021 school year. Schools noted difficulties with remote learning, including decreased attendance and engagement during virtual classes, and Regents exams were canceled from the spring of 2020 through January 2022.[1] The inability to gather in person also substantially affected the availability of work-based learning opportunities. Schools and partners adapted in various ways to provide students with career and college opportunities during this time.

THE IMPACTS OF THE P-TECH 9-14 MODEL

Previous reports from this study found that students who won lotteries to attend the P-TECH 9-14 schools (the P-TECH 9-14 group) earned more high school credits and more college-level credits through dual enrollment during high school than students who did not win those lotteries (the comparison group). This report presents effects on additional high school outcomes including graduation and internship participation, as well as outcomes related to Years 1 through 3 of postsecondary education.

1. Regents exams are New York State exams in core subjects required to graduate from high school.

As well as the full sample of students, the report presents findings for those students who were enrolled in four years of high school before the educational disruptions caused by the COVID-19 pandemic (the pre-COVID subgroup) and those whose high school careers were disrupted by it in some way (the COVID-affected subgroup). The report also presents findings for male and female students, since an earlier report in this study of the impacts of P-TECH 9-14 on dual enrollment found stronger effects for young women than for young men.[2]

This report contains the finding that P-TECH 9-14 schools had larger impacts on college degrees earned within three years of high school graduation for young men than for young women. Overall, this study found that by the end of three years of postsecondary education, 13 percent of students in the P-TECH 9-14 group had completed postsecondary degrees, compared with 8 percent of the students in the comparison group, a statistically significant 5 percentage point impact. This overall impact, however, primarily reflects an impact among young men. Seven years after entering high school, 13 percent of male students in the P-TECH 9-14 group and only 3 percent of male students in the comparison group had earned a college degree. In contrast, female students in the P-TECH 9-14 and comparison groups earned college degrees at approximately the same rate. This difference in impacts suggests that the P-TECH 9-14 model seems to have provided an additional level of support for young men that they did not experience in other kinds of high schools, allowing them to succeed at similar rates to young women.

This finding is particularly notable because it suggests that the P-TECH 9-14 model may be helping young men buck national trends in college enrollment and degree attainment that have seen this population achieve less in these areas than young women. Nationally, male students have lagged female students in multiple markers of academic success for decades, particularly in those areas of college enrollment and degree attainment.[3] At the same time, these findings add to a body of literature that have found CTE engagement can have positive impacts for young men, including an MDRC evaluation of Career Academies, some recent studies of regional vocational technical high schools in Connecticut, and an early evaluation of a high school internship program.[4] Moreover, as in this study, most of those other studies

2. Michelle Dixon and Rachel Rosen, *On Ramp to College: Dual Enrollment Impacts from the Evaluation of New York City's P-TECH 9-14 Schools* (New York: MDRC, 2022).

3. Dylan Conger, "High School Grades, Admissions Policies, and the Gender Gap in College Enrollment," *Economics of Education Review* 46 (2015): 144–147; Dylan Conger and Mark C. Long, "Why are Men Falling Behind? Gender Gaps in College Performance and Persistence," *Annals of the American Academy of Political and Social Science* 627, 1 (2010): 184–214; Nicole M. Fortin, Philip Oreopoulos, and Shelley Phipps, "Leaving Boys Behind: Gender Disparities in High Academic Achievement," *Journal of Human Resources* 50, 3 (2015): 549–579; Statista Research Service, "Undergraduate Enrollment Numbers in the United States from 1970 to 2030, by Gender" (website: https://www.statista.com/statistics/236360/undergraduate-enrollment-in-us-by-gender/, 2021).

4. James J. Kemple and Cynthia J. Willner, *Career Academies: Long-Term Impacts on Work, Education, and Transitions to Adulthood* (New York: MDRC, 2008); Eric J. Brunner, Shaun M. Dougherty, and Stephen L. Ross, "The Effects of Career and Technical Education: Evidence from the Connecticut Technical High School System," *Review of Economics and Statistics* 105, 4 (2023): 867–882; Brett Theodos, Michael R. Pergamit, Devlin Hanson, Sara Edelstein, and Rebecca Daniels, *Embarking on College and Career: Interim Evaluation of Urban Alliance* (Washington, DC: Urban Institute, 2016), although the positive results mentioned were not found in the longer-term follow-up study of the same program.

did not find impacts for female students, because female students engaged in postsecondary education at similar rates, whether they received CTE or not.

It is important to note that the findings from this report are difficult to compare with those of studies of other postsecondary interventions. Most studies of postsecondary education begin with a sample of students who have chosen to enroll in college and, by definition, do not include those students who never enroll in college. In contrast, this study begins with students in the ninth grade, many of whom will not enroll in college at all in the years that can be measured, after the end of four years of high school, which may make the impacts seem relatively small compared with some other postsecondary interventions. But the samples are not the same and this impact on postsecondary outcomes is therefore still noteworthy.

This study also found that students in the P-TECH 9-14 group participated in internships at much higher rates than students in the comparison group, and were 26 percentage points more likely to participate in dual enrollment than students in the comparison group. There were not significant differences between the two groups in the percentages who graduated high school after four years. Students in the P-TECH 9-14 group who attended high school during the years disrupted by the pandemic were still more likely to participate in internships and dual enrollment than students in the comparison group during those years, but the impacts are even larger for students who attended high school before the pandemic.

The cost study found that secondary education costs (those costs incurred when students were enrolled at high school) were about 17 percent higher per student for the P-TECH 9-14 group than the comparison group. The additional costs were due to P-TECH 9-14 schools' smaller size, city designation as CTE schools (which brings with it extra funding), dedicated support from the school district's central office, and industry partner investments. P-TECH 9-14 schools also received secondary education funding for supporting students who elected to continue along the school's postsecondary degree pathway after their senior year of high school. Postsecondary education costs were also higher for the P-TECH 9-14 group, as would be expected for a model that sought to have students complete both high school and postsecondary degrees within six years.

The cost-effectiveness assessment was inconclusive. The study calculated costs for two entering classes (cohorts) of students in the analytic sample. For the first, the model was cost-effective, meaning the cost per degree earned was less for the P-TECH 9-14 group than the comparison group. In that cohort, the P-TECH 9-14 group participated in dual enrollment more frequently and earned more postsecondary degrees than the comparison group. The model was not cost-effective for the second cohort because students in the P-TECH 9-14 group in that cohort did not participate in dual enrollment as often and earned postsecondary degrees at similar rates to the comparison group. These findings suggest that for the model to be cost-effective, students need to engage in its postsecondary elements.

CONCLUSION AND NEXT STEPS

This report provides evidence that the NYC P-TECH 9-14 schools were effective at supporting students to earn more postsecondary degrees than students in the comparison group, up to three years past expected high school graduation, particularly for young men.

However, a majority of students in the analytic sample were still enrolled in postsecondary education at the end of the study period. A longer research timeline would make it possible to follow students to the end of their postsecondary education. Extending the research in that way would make it possible to obtain a more complete picture of the P-TECH 9-14 model's effects on students' postsecondary success and of the model's longer-term cost-effectiveness or monetary benefits.

1

Introduction

The first P-TECH 9-14 school opened in Brooklyn, NY, in 2011.[1] A collaboration among New York City Public Schools (NYCPS), the City University of New York (CUNY), and IBM, the school was a six-year high school, allowing students to earn both a high school diploma and a free applied associate's degree in a science, technology, engineering, or math (STEM) field at a partner CUNY campus simultaneously. IBM, the schools' employer partner, provided internships and other work-based learning experiences for students, and the two associate's degrees students could earn were in fields related to the work of IBM. Students who completed degrees were also first in line for entry-level jobs at IBM.

Since the first school opened, New York City has opened a total of nine P-TECH 9-14 schools that enroll students from grade 9 through two years of postsecondary education.[2] The first seven of these schools have taken part in a rigorous evaluation conducted by MDRC and funded by the U.S. Department of Education's Institute of Education Sciences, for which this report is the latest installment. While each of these schools is somewhat different, the basic elements of the model are the same, where each school has one or more employer partners and the college degrees offered are in fields related to the work of the industry partner, creating a pipeline of talent into specific, high-demand industries.

In addition to the schools located within New York City, the state of New York has thus far provided funding for 48 P-TECH 9-14 schools, with 12 more announced in 2023 and the potential for more to be added in coming years.[3] The model has also proliferated nationally, with more than 200 schools spread across 13 states. There are even P-TECH model schools in as many as 27 other countries.[4] Despite this expansion, there is no formal organizing body for P-TECH model schools, leaving flexibility for schools to adapt the model to local needs.

1. P-TECH, "Learn About P-TECH's History" (n.d.).
2. NYC P-TECH Schools (n.d.).
3. New York State (2023).
4. P-TECH, "Our Schools" (n.d.). While the New York City model is named "9-14" because it includes grades 9 through two years of postsecondary education, in some other places the grade spans are different. For this reason, in this report only the New York schools include "9-14" in the name. "P-TECH 9-14" is also the name used by local partners.

The model has had an intuitive appeal for both policymakers and practitioners, who have praised it as a new way to educate students for both career and college.[5] It combines elements of other school models that have proved successful for improving student outcomes, including Career Academies, Early College High Schools, and the New York City small high schools of choice reform, in which small high schools that enroll an average of 129 students per entering ninth-grade class were created across the city.[6] The P-TECH 9-14 model serves as a test of how evidence-based education models can be implemented, adapted, and expanded to a larger scale.

The MDRC evaluation provides the first rigorous evidence of the P-TECH 9-14 model's impacts on student outcomes. The study uses a lottery-based random assignment design that takes advantage of the nature of the New York City high school admissions process, in which students were randomly offered or not offered an opportunity to attend a P-TECH 9-14 school. This type of analysis is similar to a random assignment study, allowing researchers to draw comparisons between groups of students, while attributing differences in outcomes to the opportunity to attend the schools, rather than to other factors such as student motivation or other characteristics. It compares the outcomes of students who won the opportunity to attend a P-TECH 9-14 school (the P-TECH 9-14 group) with the outcomes of those who did not (the comparison group).[7]

The study also investigates how P-TECH 9-14 schools implemented the elements of the model, and where implementation varied among schools. Insights from the implementation research provide context for the impact findings. The research team also investigated differences between the educational experiences of students who attended P-TECH 9-14 schools and the experiences of students in the comparison group at the schools they attended. This look at "service contrast" helps reveal whether P-TECH 9-14 schools create different educational conditions and opportunities from those that the comparison group experienced (the counterfactual). This final report further contains a cost and cost-effectiveness analysis, which assesses the impacts relative to the cost of obtaining them. The analysis provides information about the resources used to operate P-TECH 9-14, in order to help states and districts understand what is required to run P-TECH 9-14 model schools and the potential payoff of the investment in this model.

Thus far, this study has yielded two earlier reports that provided evidence about interim impacts of the program on student progress. In the first report, the research team found that, by the end of three years of high school, students who had the opportunity to attend P-TECH 9-14 schools had earned more high school credits than their counterparts in other schools.[8] They were also more likely to have passed the New York State Regents exam in

5. Decker and Cramer (2013).
6. Kemple and Wilner (2008); Bloom and Unterman (2014); Edmunds et al. (2022); Bloom, Thompson, and Unterman (2010).
7. More detail on this analysis is provided in Chapter 4 and Appendix A.
8. Rosen et al. (2020).

English language arts (ELA) at a level making them eligible to enroll in college courses at CUNY, and did so earlier in their high school careers.[9] That report speculated that these early pass rates may have indicated that students in the P-TECH 9-14 group were more likely to be qualified earlier to enroll in college courses while in high school than their comparison group counterparts.

A second report focused specifically on dual enrollment — enrolling in college-level courses while in high school — found that students in the P-TECH 9-14 group were almost 30 percentage points more likely to enroll in any college-level courses through dual enrollment by the end of four years of high school than their comparison group counterparts.[10] In addition, the study found that by the end of four years, students in the P-TECH 9-14 group had earned an average of 7.7 college credits — a little more than two college courses' worth — through dual enrollment, compared with an average of just 1.2 college credits, or less than one complete course's worth, among students in the comparison group. The findings also highlighted gender divides in dual enrollment. While both male and female students in the P-TECH 9-14 group earned more dual-enrollment credits than their counterparts in the comparison group, male students earned fewer than female students in both groups.

Findings from this report indicate that students in the P-TECH 9-14 group did have different educational experiences and outcomes than their counterparts in the comparison group. Specifically:

1. The high school, career, and college elements of the P-TECH 9-14 model were implemented at all schools, though there was also variation in the opportunities available and how the specific elements of the model were implemented across the schools. Graduating with the affiliated associate's degree is just one of many potential postsecondary options that school staff members may advise a student to take.

2. Students in the P-TECH 9-14 group were 38 percentage points more likely to have had an internship during four years of high school than students in the comparison group.

3. By the end of four years of high school, 46 percent of students in the P-TECH 9-14 group had earned any college-level credits, compared with 20 percent of students in the comparison group.

4. Seven years after entering high school, students in the P-TECH 9-14 group were 5 percentage points more likely to have completed an associate's degree than students in the comparison group. These impacts primarily reflect results among young men: 13 percent

9. In New York State, all high school students must pass a series of standardized tests called Regents exams in order to graduate high school. To be admitted to CUNY, students must pass the math and ELA exams with a threshold score that is higher than the score required to earn a high school diploma.

10. Dixon and Rosen (2022).

of young men in the P-TECH 9-14 group had completed an associate's degree, compared with 3 percent of young men in the comparison group.

5. The cost analysis shows that P-TECH 9-14 schools can generally be operated with resources that are not significantly different from those expended on other high schools in the community. Postsecondary costs were higher for the P-TECH 9-14 group, as would be expected for a model that sought to have students complete both high school and postsecondary degrees within six years. The findings about the model's cost-effectiveness in producing postsecondary degrees at six years are inconclusive. Additional cost analyses over longer periods are needed.

These findings are timely for several reasons. First, since the 2018 reauthorization of the Carl D. Perkins Act (the federal law that provides federal funding for CTE), federal law has put more emphasis on the expansion of high-quality CTE tied to the labor market.[11] This expansion, as well as the rapid nationwide growth of P-TECH 9-14 model schools, makes the present study more important than ever. In addition, the COVID-19 pandemic has made it more urgent to find evidence about effective educational models, particularly for students from marginalized communities hit hardest by COVID-19, as the pandemic has accelerated existing declines in postsecondary enrollment rates.[12] Additionally, 20 percent of community college student enrollments are now dual-enrolled high school students, making it ever more important to gauge the extent to which dual enrollment leads to postsecondary enrollment and degree attainment.[13]

OVERVIEW OF THE P-TECH 9-14 MODEL

Figure 1.1 provides a high-level logic model for the P-TECH 9-14 model. As shown in the "inputs" column, P-TECH 9-14 schools involve a three-way partnership among a high school, a community college, and an employer partner. In the P-TECH 9-14 schools in New York City, high schools are partnered with a college campus from CUNY and one or more employer partners. Each partner provides P-TECH 9-14 schools with resources that include donations of staff time, money, and equipment and other material. Additionally, the schools receive support from the central offices at NYCPS and CUNY, including identification of initial employer partners, support for school launch, and ongoing professional development opportunities for school staff members related to preparing students for college and career.

With these inputs, schools can offer a variety of opportunities to students. In high school, these experiences include accelerated coursework, early opportunities to take Regents exams, CTE coursework, soft-skills instruction, and college and career advising.[14] Students may also

11. Northern and Petrilli (2019).

12. Meyer (2023).

13. Fink (2023).

14. "Soft skills" refer to the general habits and competencies that make for an effective employee, such

Figure 1.1

P-TECH 9-14 Logic Model

Inputs

Three-way partnership among:

- High school
- Community college
- Employer partner(s)

Resources:

- Personnel, fiscal, and in-kind resources from high school, college, employer(s)
- Additional support from New York City Public Schools and City University of New York

Opportunities
Intervention Core Components

High school:

- Accelerated courses and exams
- Career and technical education (CTE) and soft skills courses
- College/career advising

Career:

- Work-based learning experiences such as workplace visits, mentoring, and internships

College:

- College courses for an associate's degree in a STEM field aligned with high school CTE courses, with dual enrollment as early as 10th grade

Short-Term Outcomes

- Increase in high school CTE course taking
- Increase in Regents exam pass rates
- Increase in participation in work-based learning activities
- Increase in dual-enrollment credits related to the career pathway

Long-Term Outcomes

- Increase in high school graduation rates
- Increase in postsecondary enrollment
- Increase in associate's degree receipt
- Increased employment in good jobs

Context

Open enrollment/lottery process, small school size, support for postsecondary planning, New York City Public Schools' college- and career-readiness policy, school environment participate in career-focused, work-based learning opportunities offered by the employer partner(s), for example workplace visits, mentoring, and internships. Finally, schools also offer students the opportunity to participate in early college classes with the CUNY partner in a STEM course of study beginning in tenth grade. These activities are meant to increase the percentages of students who take high school CTE courses, pass Regents exams, participate in work-based learning activities, and earn college-level credits while in high school (the “short-term outcomes” column). In the long term, those outcomes are expected to increase high school graduation rates, postsecondary enrollment, associate’s degree receipt, and employment in good jobs (the “long-term outcomes” column). As noted in the “context” box, P-TECH 9-14 schools exist in a system that keeps the number of students at those schools small, uses an open enrollment process and lotteries to assign spots in P-TECH when more students wish to attend than a school can accept, and provides support for postsecondary planning.

THIS REPORT

Chapter 2 of this report provides updated evidence about the implementation of the high school elements of the model, as well as new information about college- and career-related advising practices in the P-TECH 9-14 schools and a look at how the schools responded to the pandemic. Chapter 3 provides evidence about the differences between the school experiences of students who enrolled in P-TECH 9-14 schools and those of students who enrolled in other kinds of schools. These differences include measures of teacher, student, and parent impressions of the schools. Chapter 4 details the impacts of the P-TECH 9-14 model, including impacts on the percentages of students who participated in internships and dual enrollment, and on academic outcomes of interest such as high school credit accumulation, high school graduation, postsecondary enrollment, and postsecondary degree attainment within seven years of entering high school. It also compares P-TECH 9-14’s impacts for students who experienced four years of high school before the pandemic with its impacts for those whose high school experience was affected by the pandemic, and compares its impacts for young men and women. Chapter 5 provides cost estimates and a cost-effectiveness analysis to help both policymakers and practitioners understand the cost trade-offs between P-TECH 9-14 model schools and other models that support high-school-to-postsecondary transitions. Chapter 6 concludes the report with implications for policy and future research.

as arriving at work on time, cooperating with coworkers, taking and giving direction, communicating clearly, and dressing appropriately for the workplace.

2

Implementation

This chapter provides details about how the P-TECH 9-14 model was implemented in the seven study schools. The findings in this chapter are based on interviews conducted with school leaders and staff members, students, school district staff members, and higher education and employer partners between 2018 and 2023, and on a survey of P-TECH 9-14 school leaders conducted during the 2018-2019 school year.[1] First, this chapter discusses how the P-TECH 9-14 schools define success for their students, to help readers understand the overall goals of the model from the schools' perspectives. Next, the chapter provides details about each of the model's three components — high school, career activities, and college courses — with a focus on both similarities and differences across the seven study schools. After that, the chapter includes a section on several of the factors that appear to determine some of the variation in what students experience in the P-TECH 9-14 model. Finally, the chapter concludes with a brief discussion of considerations for implementation of the P-TECH 9-14 model.

Findings:

- Having students graduate with the affiliated associate's degree is not the primary goal at most of the schools, and that degree is just one of many postsecondary options for students.
- P-TECH 9-14 schools maintain a dual focus on college and career, with all study schools providing opportunities for students to engage in college classes, career exploration, and work-based learning activities.
- The P-TECH 9-14 model requires substantial coordination and relationship management across high school, employer, and college partners.

1. Interviews with the study schools took place during the 2017-2018, 2018-2019, and 2021-2022 school years; interviews with employer partners took place during the summers of 2018 and 2021; interviews with college partners took place in the summer of 2018; interviews with district-level staff members took place in 2022. See Appendix A for details on the coding and analysis of interview data. Note that the implementation data collection does not align perfectly with the timeline of the impact data due to the timing of the grant and the retrospective nature of the quantitative data. Visits were also originally planned for the springs of 2020 and 2021, but those visits were canceled due to COVID-19.

- The COVID-19 pandemic interrupted the implementation of the elements of P-TECH 9-14 at all schools. Schools and partners adapted in various ways to provide students with career and college opportunities during this time.

DEFINITIONS OF SUCCESS AT P-TECH 9-14 SCHOOLS

One goal of the implementation study was to understand how P-TECH 9-14 schools define success for their students. School leaders play a critical role in setting priorities for their staff members and determining the overall focus of the school, so understanding how they view the model can be especially instructive for understanding students' experiences. Interviews with staff members across the P-TECH 9-14 schools made it clear that every school includes a dual focus on college and career, with nearly every school including goals related to both college and career preparation in its definition of success for students.

While students at every school have the option to pursue the associate's degree at the affiliated college, most of the P-TECH 9-14 school leaders shared that they do not believe their mission is to have as many students as possible remain at the school through grade 14. Rather, they acknowledged that students have a wide variety of interests, often beyond the school's career and technical education (CTE) pathways, and their definitions of success centered on ensuring that students develop a wide range of skills to prepare them for the postsecondary options of their choice. Only two of the seven principals indicated that they actively encouraged students to stay through grade 14 to complete associate's degrees through the school-specific P-TECH 9-14 pathway. One principal stated, "I am unapologetic with my definition of success: It is earning the [affiliated] degree, so that way you can be first in line for the job at [our employer partner] or halfway through a four-year degree program." At the other P-TECH 9-14 schools, school leaders said they took a more nuanced approach. School leaders at four of the schools explained that they do not encourage all students to pursue any one pathway over another (that is, staying for the degree offered as opposed to applying to another two-or four-year college), and that they expect school staff members to work with students to find paths that match their needs and interests. One school principal said:

> At P-TECH schools, you know, the degree pathways are so specialized. And [due to the high school application process] we cast a wide net throughout the whole city to attract our ninth-graders. I'm not just bringing in kids who are passionate about the [specific programs of study we offer].... There may be kids who become passionate about [our programs] and those are kids that I might encourage to stay, or would certainly encourage to stay. But I also have students who want to be forensic psychologists and nurses and pharmacists and lawyers, and it doesn't make sense for me to counsel them to remain within this program.

School staff members at two of the schools went even further and explained that they more frequently encourage students to complete degrees at other colleges, often four-year programs if students get accepted. They said they view their early college programs as a way to obtain college credits that can be transferred to other postsecondary institutions. It is worth noting that the study schools that opened earlier were more likely to encourage students to complete the school's affiliated degree than those that opened later. Similarly, interviews with district administrators also suggested that they put less of an emphasis over time on ensuring that students complete the affiliated postsecondary degree. It was not clear, however, whether this was an intentional shift or one that happened gradually over time in response to factors such as different levels of student interest in the specific associate's degrees offered by the P-TECH 9-14 partner colleges.

Regarding careers, school staff members included having access to meaningful career exploration and work-based learning (WBL) activities as a marker of success of the P-TECH 9-14 model. Staff members at three schools considered it a success if students had one meaningful WBL activity (for example internships or job shadowing), and at two they stressed that the goal was for students to have paid WBL experiences. Staff members at two schools said that they wanted students to gain skills and experiences that would allow them to be successful in any work environment, and highlighted the importance of teaching soft skills that are adaptable across many industries. Only one school explicitly stated that the goal was for students to get full-time jobs at the industry partner after graduation.

School staff members also spoke about how families' perspectives about success play an important role in students' choice to attend a P-TECH 9-14 school and the choices that students make about pursuing particular paths. See Box 2.1 for more detail.

IMPLEMENTATION OF MODEL COMPONENTS

To achieve their goal of preparing students for college and career, P-TECH 9-14 schools focus on integrating three components — high school, college, and career activities — that are all aligned (as depicted in Figure 1.1). Each school focuses on a particular science, technology, engineering, or math (STEM) subject and career. For example, one school focuses on health careers. In that school, the high school–level CTE work focuses on public health, the work-based learning takes place at the local hospital, and college courses are available that allow students to pursue degrees in community health and nursing.

This section includes findings about how each of these components is implemented across the study schools. Overall, the three components are being implemented in all the study schools, but there is also variation in the opportunities available and how the specific elements of the model are implemented. The section of the chapter after this one provides details about several factors causing this variation.

High School

P-TECH 9-14 schools have many things in common with traditional four-year New York City Public Schools (NYCPS) high schools. P-TECH 9-14 students are required to meet NYCPS's

BOX 2.1

The Influence of Families

School staff members reported that families' perspectives strongly influence why students may choose to attend a P-TECH 9-14 school and what postsecondary options they may later choose. According to them, parents are drawn to P-TECH 9-14 schools for many reasons, most notably having access to a free college degree and the opportunity to earn free college credits. Similarly, school staff members reported that the specific industry pathway or partner may lead families to encourage their children to apply to P-TECH 9-14 schools. P-TECH 9-14 schools also have a reputation for safety that may attract families.

Almost every school mentioned that parents have expectations or desires for their children to make certain pathway or program choices. Most of the schools also reported that family circumstances (for example, those related to immigration status and access to financial aid) or desires for children to be close to home rather than going away to college influence students' choices to pursue particular career pathways or college courses at their P-TECH 9-14 schools. Schools work with families to keep them informed of their students' progress and different postsecondary options beyond the associate's degree pathway. Schools also work to communicate with parents about what postsecondary options might best suit their children. This communication is especially important for students who may be struggling to attain the grades or exam scores needed to participate in aspects of the model such as college courses or internship opportunities. As some of the P-TECH 9-14 schools have evolved, they have worked to manage parents' expectations coming into a school, so that they have a better understanding of what students will and will not get out of it. As one guidance counselor reported:

> I think in the beginning … there was this understanding that [school] meant free college. And then it didn't become apparent that free college … came with requirements and it was at [campus partner], not just any CUNY, and it had to be one of three (specific pathways).... It couldn't just be any. And not all credits were transferring in the beginning. We now have a clearer, better way of communicating what that means to stay with us and then to opt in your senior year to continue on with the program if you feel that is the best decision for you.

high school graduation requirements to receive a high school diploma and the schools have many of the elements one would expect to see in a typical high school, including extracurricular activities and sports teams.[2] There are several distinguishing features specific to

2. Students in the New York City school system can graduate with either a Regents diploma or an advanced Regents diploma, both of which require 44 credits to graduate. For "on-time" graduation, students must meet these requirements within four years. To earn Regents diplomas, students need to pass five Regents exams (in English language arts, math, social studies, science, and one additional subject), while students aiming for an advanced Regents diploma need to pass nine Regents exams. Regents

P-TECH 9-14 high schools related to schools' dual focus on college and career, including accelerated courses and early exam taking, CTE classes and soft-skills instruction, and advising related to career and college.

Accelerated Courses and Exams

Some courses and exams must be completed earlier in P-TECH 9-14 schools than in a typical NYCPS school, to set students up for the possibility of taking college courses while in high school. First, P-TECH 9-14 schools reported that some high school courses required for graduation are front-loaded. As described in this study's first report, students in the P-TECH 9-14 group attempted significantly more high school courses in the first three years than did comparison group students, with an average of 0.7 additional credits attempted in Year 1, 1.5 additional total credits attempted by the end of Year 2, and 2.5 additional total credits attempted by the end of Year 3.[3] Students also earned significantly more total credits in Years 2 and 3.

In addition, P-TECH 9-14 students take many Regents exams earlier than they otherwise would. The City University of New York (CUNY) requires students to achieve a college-ready score in English language arts (ELA) and one math subject before they can begin taking most courses specific to P-TECH 9-14 degrees.[4] P-TECH 9-14 students begin taking these Regents exams as early as the summer before ninth grade and are encouraged to have attempted them by the end of their tenth-grade year. MDRC's previous report found that students in the P-TECH 9-14 group attempted more Regents exams than comparison group students and that a higher percentage of them passed the ELA exam with a score qualifying them for enrollment in CUNY courses in each of the first three years of high school.[5]

CTE Classes and Soft-Skills Instruction

The P-TECH 9-14 high schools are all considered CTE high schools by NYCPS, with all students enrolled in a CTE program of study.[6] Students must participate in one of their school's specified CTE pathways, which align with the college degree(s) offered through their school's college partner. In CTE classes, students are exposed to content and skills related to the

exams were canceled between the spring of 2020 and January 2022 due to COVID-19; students could take the exams later or receive a waiver instead. See New York City Public Schools (2023b).

3. See Rosen et al. (2020). In the study schools, 1 credit is most commonly equivalent to one class, with nearly 75 percent of classes being worth 1 credit, 16 percent being worth 0.5 credits, and 3 percent being worth 2 credits.
4. In New York State, a passing score on these exams for a Regents high school diploma is 65 or higher. See New York State Education Department (n.d.). However, CUNY requires students to have higher scores on ELA and math Regents exams in order to demonstrate college readiness and qualify to skip remedial classes and start an associate's degree program. Some CUNY campuses allow students to take one-entry level course before meeting the college-ready benchmark.
5. Rosen et al. (2020).
6. NYCPS CTE programs must meet quality indicators that are outlined through the New York State Education Department's CTE program approval process. All CTE programs incorporate the following components: curriculum and instruction, work-based learning, industry and postsecondary partnerships, and assessment and accountability. See New York City Career and Technical Education (2023).

career focus area of their school, and they begin to prepare for WBL activities. For example, one school staff member said:

> We have project-based learning and a workplace challenge that we do with certain partners, and that will also add onto [students'] skills and their development and [build on the] curriculum that they're learning in class. And then by the twelfth-grade year, we should be able to send them off to actual internships to represent the school and build their career portfolio.

In addition to or as part of CTE classes, the P-TECH 9-14 schools explicitly focus on "soft skills" or "professional skills," which may include skills related to social-emotional topics, time management, communication, and organization.[7] The schools also teach related professional skills such as writing a résumé, interviewing for a job, and speaking before an audience during specific college- and career-studies classes or during noncredit advisory periods. These offerings are meant to complement the WBL experiences, preparing students to obtain work and perform satisfactorily in the workplace.

Career and College Advising

Because P-TECH 9-14 schools aim to prepare students for many kinds of postsecondary options, not only the affiliated associate's degree, career and college planning is an important part of P-TECH 9-14 advising. Postsecondary planning most often begins in tenth grade, though some schools start in eleventh grade. While all schools have advisory courses that may dedicate time to this type of planning, most also have other staff members (for example, guidance counselors, WBL coordinators, or CTE teachers) who introduce planning for college and careers.[8] Most schools administer surveys at least once during high school that are intended to help students identify interests in various careers. In the culture of P-TECH 9-14 schools, career planning is explicitly tied to college planning. While in many ways, college counseling at P-TECH 9-14 schools looks similar to that in typical high schools, guidance counselors work with students to weigh their postsecondary options, considering their school's affiliated associate's degree as one option.

Career Activities and Work-Based Learning

The next component of the P-TECH 9-14 model is its focus on providing WBL opportunities. Career exposure and experience complement students' CTE and college courses, giving them an understanding of what a career in the school's field of focus would be like after high school and college. The WBL opportunities are provided by an employer partner, and may take place in the school building or at a workplace. This subsection discusses the partnerships between schools and employer partners and the specific WBL activities provided.

7. Soft skills may also be referred to as 21st-century skills or career skills.

8. Advisory courses are nonacademic classes, often shorter than other classes, that meet regularly to instruct students in areas such as social-emotional learning and soft skills.

Industry Partnerships

Employer partners are central to P-TECH 9-14 schools' WBL opportunities. Each school has a flagship partner involved from the school's inception, and all but one of the study schools have enlisted additional partners over time to increase the number of WBL opportunities for students. While additional partners are often in the same industry, two schools sought out employers in different industries to provide activities that appeal to more students. Not all partners have the ability to engage in all activities — which can range from weekly workplace visits to providing mentors to hosting students for internships. Though a commitment to providing jobs for graduates who earn the school's affiliate associate's degree was one of the design principles of the first P-TECH 9-14 school, most of the employer partners do not make that same commitment. Instead they view themselves as a connection to the workplace and supporter of professional skills.

Maintaining the relationships with their employer partners is an important aspect of the management of P-TECH 9-14 schools. Schools reported that staff members meet one to four times per month with their industry partner(s) to discuss topics such as creating internship descriptions together and planning for WBL activities. In all schools, the principal or other school leaders remain very involved in the relationship with the employer partners. In addition, all schools have designated staff members, often called WBL coordinators, who officially spend at least some portion of their time focused on students' engagement in WBL, including overseeing soft-skills instruction, securing WBL opportunities and managing their logistics, and keeping in contact with employer partners.

WBL Activities

Each of the P-TECH 9-14 schools provides a variety of WBL activities to students, with WBL activities in the early grades focused on exposure to work in a particular industry and activities that build awareness of industry roles, and later activities involving more intensive and hands-on career exploration and training opportunities. Early career exploration and awareness activities, including workplace visits, guest speakers, and career fairs are available to all P-TECH 9-14 students in some capacity. All P-TECH 9-14 schools, for example, reported bringing in career-focused speakers. In most of the schools, most ninth-graders also visit job sites to learn about the company's work and the types of jobs available; in three schools, tenth-graders also participate in regular workplace visits. Note that this finding reflects data collected before the COVID-19 pandemic; schools and industry partners have varied in the extent to which they have returned to in-person job-site visits over the ensuing years. In many of the schools, students also engage in projects or present their work to industry professionals. WBL in the early grades is often a part of CTE classes, and many schools make a point of connecting WBL to students' non-CTE high school coursework as well.

Schools varied in the amount and intensity of professional mentoring offered to students. While all schools have had mentoring programs at one point, about half start providing mentors to ninth- and tenth-graders; mentorship at that stage often focuses on both industry exposure and having a dedicated person to work with individuals or small groups of students to begin building professional skills.[9] Other schools wait until later grades to provide mentoring, when students have had greater exposure to WBL activities and school staff members believe they are better prepared to have mentors support their professional skills through activities such as résumé building and interview preparation. Many schools and employer partners reported that mentoring was a particularly challenging WBL activity to offer. Employer partners had to recruit and train their staff to participate. It also requires a lot of logistical support to schedule visits and navigate NYCPS approval processes for employer-partner staff members to enter the school.

Finally, paid internships, which typically take place in eleventh and twelfth grade and are often considered the pinnacle of WBL activities, are available in some form at all P-TECH 9-14 schools. However, there is wide variation in the number of industry-connected internships schools are able to secure for their students, and few schools are able to provide industry-connected internships to most students. While one school's employer partner is able to provide 50 internship spots per year, most partners can only commit to 3 to 5 internships. To increase that number, almost all the P-TECH 9-14 schools reported that many students complete paid internships through New York City's Summer Youth Employment Program (SYEP), which provides students with paid internship or work opportunities over the summer.[10] Through this program, students may work for a variety of organizations across different industry sectors, whether or not they are aligned with the school's field of focus. The number of Summer Youth Employment Program slots provided to P-TECH 9-14 schools varies, with schools reporting that they typically receive enough slots for between 10 percent and 40 percent of their students. Two schools also noted that some of their students stay in these internships during the school year.

College Activities

The final element of the P-TECH 9-14 model is college coursework. The specific degree pathways are designed to complement the high school CTE classes and lead to credentials tied to specific careers associated with the high school's STEM field of focus. Each P-TECH 9-14 school has two to five degree pathways; at most schools, the degree pathways are in similar fields. Almost all the degree pathways existed at the affiliated CUNY campus before

9. While some schools were able to shift to offering mentoring virtually during the COVID-19 pandemic, others put their programs on hold. In particular, schools with employer partners in the health care field put their mentoring programs on hold, as staff priorities and availability changed. Almost all schools have returned to providing mentoring opportunities to students, though the program is still on hold at one school.

10. New York City's Summer Youth Employment Program is run by the Department of Youth and Community Development. Students are placed in paid work experiences through either a randomized lottery or through slots that are provided to certain public schools that participate in CareerReady SYEP (see Chapter 3 for more information). Four P-TECH 9-14 schools are designated as CareerReady SYEP schools. In these schools, the WBL coordinator helps match students to work opportunities that will be paid with Summer Youth Employment Program funds. New York City Department of Youth and Community Development (n.d.).

the college began partnering with its P-TECH 9-14 school. This section includes details about the P-TECH 9-14 schools' partnerships with local colleges and how early college courses and courses in grades 13 and 14 are implemented.

College Partnerships

Each P-TECH 9-14 school is partnered with one CUNY college partner. The high school and college campus reach agreement on when in high school students can begin those courses, which courses students may take, and in what sequence they should take the courses. The relationships between high school and college partners also involve a substantial level of management, and school staff members shared that the relationships have also evolved over the years of working together, so that most high schools see their colleges as true partners who agree with them about what is best for students. Each P-TECH 9-14 school has a college liaison hired by the CUNY college who splits time between the high school and college campus. The college liaison plays a critical role in supporting the school-to-college relationship and works closely with the high school's guidance counselors to oversee the logistics of sharing students across campuses. The liaison also acts as the primary point of connection across the two different systems. High schools and colleges operate on different calendars, have different expectations of students, and often engage students differently; the college liaison helps schools and students negotiate these challenges, and for some schools, facilitates engagement between the high school's staff and college professors teaching P-TECH 9-14 students.

Early College

All P-TECH 9-14 schools allow students to participate in dual enrollment — taking college classes while in high school — by the spring of tenth grade. However, not all students enroll in college courses while in high school. Students who do enroll begin by taking more general college courses first, moving into courses more specific to their particular degree over time. Students have little flexibility in course selection due to the specific scope and sequence of the degree pathway. Most schools offer one or two courses to tenth-graders as an introduction to college work and then offer more classes to eleventh- and twelfth-graders. For those earliest college-level courses, students do not always need to have "college-ready" Regents scores, potentially opening college opportunities to more students. School staff members also reported that they view many of these early classes as providing credits that can be more easily transferred to non-CUNY colleges; data limitations prevent the study team from verifying whether that view is correct.

All the college courses are taught by college instructors and, at all but one of the schools, one or more of the earliest college courses are taught by a college instructor who comes to the high school, with students moving to the college campus for some or all classes by eleventh or twelfth grade. Students at most schools start their college classes in sections that are specifically for P-TECH 9-14 students. As students progress, they may be integrated into college classes with other college students. Some college courses may be offered during additional time outside of the regular school schedule for students, including before or after school, on the weekend, or during the summer.

Grades 13 and 14

P-TECH 9-14 programs have planned six-year scopes and sequences, so students may choose to remain in the program beyond grade 12 and take an additional two years to complete their associate's degree in grades 13 and 14. As discussed above, remaining in the model is not required, and many students choose to leave after twelfth grade. Students who remain at their P-TECH 9-14 schools for grades 13 and 14 are expected to take a full-time college course load (15 credits/semester) on the CUNY campus during those years. Students are mostly enrolled in courses specific to the associate's degree, for example in engineering or information technology. While some students may begin to take major-related courses before this time, two schools that have more than one degree pathway do not have students select their major until the beginning of grade 13. In order to receive the free degree, P-TECH 9-14 students must complete the degree by the end of grade 14 in the designated P-TECH 9-14 degree pathway at the college-partner CUNY campus. High schools vary in terms of the support they offer to students beginning in grade 13. At some, students have access to the college liaison on campus; at some, students remain in contact with the high school staff to receive general advice and support. Two schools integrate their programs with CUNY's Accelerated Study in Associate Programs (ASAP), and officially hand off their students from P-TECH 9-14 support to ASAP support when students move to grade 13 and become full-time college students.[11]

COVID-19 and P-TECH 9-14 Adaptations

The COVID-19 pandemic affected each component of the P-TECH 9-14 model, as all NYCPS schools moved first to a virtual format in March 2020, and continued in a hybrid model during the 2020-2021 school year. Schools noted difficulties with remote learning, including decreased attendance and engagement during virtual classes, and Regents exams were canceled from the spring of 2020 through January 2022.

The inability to gather in person substantially affected the availability of WBL opportunities. Schools offered some virtual WBL experiences, including workshops, career days, and mentoring, though many schools noted that fewer opportunities were available to students than was the case before the pandemic. At the same time, though, many opportunities that necessitate in-person interactions — for example, visits to workplaces — were halted. WBL activities were slow to come back even after students returned to class in person, due to restrictions regarding outside adults entering NYCPS schools, and staff members at the industry partners continuing to work remotely. Schools also faced challenges in engaging their industry partners because it was difficult to build meaningful connections between industry staff members and students through virtual events, and because the industry partners saw greater staff turnover.

11. CUNY developed the ASAP model to help more students complete degrees in a timely manner. It is a comprehensive program that provides community college students with up to three years of financial, academic, and other support services. MDRC has partnered with CUNY on multiple studies of ASAP, finding that it nearly doubled graduation rates. See Scrivener et al. (2015).

College courses also moved online in March 2020 and remained virtual through most of the 2020-2021 school year, and in-person opportunities for college exploration and awareness (for example, trips to the college partner) were canceled. With Regents exams canceled, high schools relied on their staffs to determine whether students were ready for college-level work. As with high school classes and WBL, schools reported a lack of engagement and lower attendance in college courses during this time. Many schools noted that enrollment in early college courses declined during the pandemic. High schools created support for virtual college classes, for example by designating specific class periods during the high school day for students to complete coursework for asynchronous college classes (classes where instructors provide material and students move through it independently, on their own timetables), but they still reported challenges in student engagement. As college courses began to meet in person once more, high schools noted challenges related to vaccine hesitation among students and families, as CUNY required COVID-19 vaccination to attend courses and a similar vaccination requirement was not put in place at NYCPS for students.[12]

Finally, several schools indicated that COVID may have been a factor in students making new choices about their postsecondary pathways. During this time, many colleges and universities made standardized tests (such as the SAT and ACT) optional for admission. School staff members noted that as a result of these less intensive application requirements, they saw more students choosing to apply to four-year colleges and universities.

FACTORS INFLUENCING VARIATION IN P-TECH 9-14 STUDENTS' OPPORTUNITIES

While all the P-TECH 9-14 schools implement the three main components of the model, there is some variation across the schools regarding the specific opportunities available to students. Also, not all P-TECH 9-14 students are able to participate in every college and career activity available at each school. This section focuses on several factors that influence why students may have different experiences between and within the P-TECH 9-14 schools in the study — specifically, relationships with partners, requirements for participation in activities, and student interests.

Schools' Relationships with Partners

Schools' relationships with employer and college partners are critical because the partners provide the WBL and college opportunities for students. What they provide and how they work with each school directly affects what students experience.

12. The percentages of students at P-TECH 9-14 schools who were fully vaccinated against COVID-19 ranged from 54 percent to 86 percent as of February 2022. Notably, students were required to be fully vaccinated (that is, two weeks past the second dose of a two-dose vaccine or two weeks past their dose of a single-dose vaccine) to attend classes on CUNY campuses between the fall of 2021 and the spring of 2023. City University of New York (2023); NYC OpenData (2022).

Working with employer partners to facilitate WBL opportunities is a complicated endeavor and the opportunities available for P-TECH 9-14 students have changed during and across the school years based on what the partners are able to provide. Schools highlighted the time commitment for staff members at the employer partner and the turnover of contacts at that partner as barriers to providing robust and consistent WBL for their students. The schools also do not have formal memoranda of understanding with their employer partners that clearly outline levels of engagement or expectations for all parties. As noted above, all but one school is also connected to more than one employer partner, which means that the schools are overseeing career activities with several partners. At the same time, some school staff members reported that students are still developing their readiness to engage in WBL activities (that is, their understanding of appropriate workplace behaviors) and industry partners may have unrealistic expectations of high school students' professionalism and job-readiness skills as students come into the workplace for internships or job-site visits. Some schools have tried to address these challenges by having a staff member with dedicated time to support WBL work closely with the employer partners, but the schools are engaged in discussion and planning for WBL opportunities throughout the year.

Schools' relationships with their college partners play a less central role in influencing variation in students' college-related experiences, as the scope and sequence for each pathway and the availability of courses are relatively stable. Several schools, however, shared that inconsistent communication and the college's perceived inflexibility in making accommodations for high school students made it challenging to provide early college courses and related support. For example, high school students might need help understanding a syllabus, or might fall behind in class and need more active intervention. It was often was difficult to communicate these needs to colleges, which made some courses less accessible for some students. Challenges can also arise in the logistics of early college classes, which can affect what students are able to participate in. For example, classes may happen on campus during times when students are unable to commute from their high school to the college campus.

Requirements for Participation

A second factor that influences what students experience at their school is requirements students must meet in order to participate in college and career activities.

More than half of schools have some kind of requirement in place to participate in certain WBL activities, for example, maintaining a certain minimum grade point average (GPA). In general, as students move from career exposure to more intensive hands-on experiences, there are fewer opportunities for students to participate in activities and more requirements they must meet to do so. Most notably, internships typically have the greatest number of requirements for participation. In addition to school requirements such as teacher or staff recommendations and GPA minimums, students often need to apply by submitting a résumé and interviewing for the position. School staff and industry partners may support this process through résumé-writing workshops and practice interview sessions, but many students still will not secure placements. Some schools also screen internship applicants before passing them along to industry partners to ensure that the industry partners are getting the students the school thinks will be successful, in part to help ensure that the partner will continue to want to host interns.

As noted above, a critical benchmark for enrolling in most college courses is meeting the CUNY benchmarks on Regents exams, which not all students do in time to participate in early college courses. Several schools also require students to meet additional benchmarks to enroll in college courses, such as meeting a GPA threshold and completing high school prerequisites. Later chapters will discuss gender differences that suggest female students may be hitting these milestones ahead of male students. College liaisons are responsible for checking that students have met the requirements before enrolling them in college courses, and for tracking the progress of enrolled students. Even after meeting the requirements to begin college courses, students may be advised to withdraw or not enroll in additional courses if they are struggling in those courses or need additional high school credits. On the other hand, students who are succeeding in college courses may be encouraged to take as many of them as possible (that is, during the summer or after school), whether or not they want to remain to complete the affiliated P-TECH 9-14 degree, so they can take advantage of the free college credits that may transfer elsewhere.

Student Interests

Finally, apart from the specific opportunities available at the school or requirements for participation, there is variation in student experiences because P-TECH 9-14 students may choose whether to participate in activities, and adults in the school may advise them differently based on their interests.

As noted above, students who enroll in P-TECH 9-14 schools are not always enthusiastic about the industries or pathways offered at the school. Staff members at P-TECH 9-14 schools reported that as a result, some students decide they do not want to engage in some of the career and college activities the schools offer. In their individual advising with students, adults in many of the P-TECH 9-14 schools use the career-interest surveys fielded early in high school to help identify potential careers and the education needed to enter them. These interest surveys also help adults in the school advise students about other, related opportunities. Some guidance counselors and WBL coordinators reported that WBL opportunities are valuable for students even if they do not have interest in the school's pathway; they still provide good work experience and can help students narrow down what they want to do. However, the limited number of some WBL opportunities combined with some students' lack of interest in them means it can be challenging to provide WBL opportunities to all students (as opposed to providing them only to students who seek them out). Opportunities are often shared by email and public postings in the school, and many schools reported that the students who participate in WBL activities are those who pursue them.

Students' interests also affect the college courses they take. Specifically, because many students do not continue with the program beyond grade 12, staff members at several schools reported enrolling students into courses that could provide credits transferable to other schools and majors, rather than courses specific to the school's prescribed pathway. One college counselor said, "Since only about a third of our students continue with us, that means the others are transferring to other schools. So we wanted to make sure that we were offering credits, classes — that the courses were transferable." If students are not continuing with their P-TECH 9-14 pathway beyond grade 12, some schools reported that they may be advised not to take major-specific courses.

DISCUSSION

School visits and interviews with adults and students engaged with the P-TECH 9-14 model make it clear that these schools maintain a dual focus on career and college, with all the study schools offering career-focused activities and opportunities to enroll in college courses for students who are qualified and interested. This study identified both similarities and differences regarding students' experiences and opportunities across and within the seven P-TECH 9-14 study schools. This section offers some summary thoughts related to the implementation of the P-TECH 9-14 model.

First, most of the schools viewed the associate's degrees at their partner institutions as just one of many potential options for students. They reported encouraging their students to pursue a variety of other paths, including applying to other two- and four-year colleges. The extent to which schools push their students to complete the degree offered by the school or to pursue other postsecondary options may reflect, in large part, the vision of the school principal.

Second, while all P-TECH 9-14 schools provide opportunities for students to engage in college and career activities, there is some variation across the schools regarding the timing, number, and types of opportunities available. Not all P-TECH 9-14 students are able to participate in every college and career activity available at the school. Factors influencing this variation include relationships with college and employer partners, requirements put in place by the school, and varied student interests.

Finally, college and employer partners play critical roles, and the relationships between them and the schools are very important and often require extensive coordination. While every school has only one college partner, all but one of the study schools have multiple employer partners, primarily to increase the number of WBL activities available for their students. It is time-consuming for school staff members to build and maintain these relationships.

3

School Experiences of Students in the Comparison Group

The previous chapter detailed how the components of the P-TECH 9-14 model are implemented. While that alone is helpful for understanding the experiences of P-TECH 9-14 students, it is also important to investigate the larger context of New York City public schools and how students in the comparison group who attended other schools might have had experiences that either differed from or were similar to those of P-TECH 9-14 students. Doing so can help illuminate whether any impacts identified are a function of receiving different opportunities, or whether a lack of impacts may be related to students in the comparison group having received similar opportunities to those of students in P-TECH 9-14 schools.

This chapter corresponds to the section of the logic model that describes the district and policy context within which this study takes place. It begins with an overview of recent initiatives from New York City Public Schools (NYCPS) and the City University of New York (CUNY) to increase college and career awareness. Information about these initiatives came from interviews with staff members from NYCPS and CUNY who could describe the support provided P-TECH 9-14 schools and schools serving comparison group students. In addition, this chapter presents data from NYCPS's annual School Climate Surveys of students, parents, and teachers to provide insight into how the school environments of P-TECH 9-14 schools compare with the environments of the schools attended by comparison group students. The chapter concludes with a summary of findings.

Findings:

- In recent years, NYCPS has undertaken concerted efforts to increase students' awareness of and access to college and work-based learning opportunities.

- Teachers in P-TECH 9-14 schools reported overall higher school quality and rated their principal's leadership more highly than did teachers of comparison group students.

- Teachers, parents, and students did not report a significant difference in the degree of postsecondary counseling available to students in the P-TECH 9-14 group versus comparison group students.

NYCPS CONTEXT AND INITIATIVES

In recent years, NYCPS has tried to increase opportunities for students to engage in college and career awareness and planning. These initiatives can provide some insight into the college and career activities that might be available to students in the comparison group, though it is important to note that the research team did not collect implementation data about these initiatives from specific schools that comparison students attended.[1]

Career Awareness and Access Initiatives

NYCPS works with other city agencies to provide New York City high school students with opportunities for career awareness and exploration. In particular, several programs are embedded in the existing Summer Youth Employment Program (SYEP) discussed in the previous chapter and focus on soft-skill development along with paid work experience.

For example, CareerReady SYEP was launched during the 2016-2017 school year. It is run in partnership with the Office of Community Schools within NYCPS, the city Department of Education's Office of Postsecondary Readiness, and the Department of Youth and Community Development.[2] CareerReady schools partner with community-based organizations that recruit students and place them in paid internships over the summer. Some community-based organizations and employers also provide opportunities such as networking events, but these tend to be more sporadic. CareerReady SYEP began in 30 schools and was expanded to around 200 schools by the summer of 2022. The majority of CareerReady SYEP programs are in community schools, which provide additional support services, including an extended school day and school year, as well as support for families, such as adult education classes for parents and access to social services. The remainder of CareerReady SYEP programs are in career and technical education (CTE) schools, including four P-TECH 9-14 schools.[3]

CareerCLUE also launched in 2016, with the intention of integrating paid work experience with exploration of specific science, technology, engineering, arts, and mathematics (STEAM) approaches, through which students earn high school course credit. Schools bring in professionals working in STEAM fields to develop content in partnership with science or English language arts (ELA) teachers. Schools also partner with SYEP to provide paid work-based

1. Students in the comparison sample were spread across 399 high schools in New York City, making it impossible to conduct interviews or field surveys for this project at every high school attended by a comparison group student. The comparison sample can be thought of as students who experienced any non-P-TECH 9-14 school in New York City. Therefore, interviews with targeted staff members at NYCPS and at CUNY informed the context across all NYCPS high schools.
2. Because of the timing of the launch, all entering classes of students in the analytic sample in this report could have had access to this program during one or more years of their expected high school enrollment.
3. New York City Department of Youth and Community Development and Workforce Connect (2021). See Chapter 2 for a discussion of New York City CTE schools.

learning experiences to students, including work-based learning projects and soft-skills training. The program targets students in ninth and tenth grade and is an opportunity for younger students to build skills that they will then apply to an internship later in their high school careers. Because the program takes a lot of resources, it has served only a small number of schools and students. At its peak it was implemented in 50 schools, though that number had shrunk to 15 schools by the summer of 2020. It serves about 30 to 60 students per school.

College Awareness and Access Initiatives

NYCPS has also created specific initiatives to promote postsecondary planning. College Access for All, which launched in 2016 and ran through 2021, was designed to increase the amount of high-quality college and career planning available to students. It gradually expanded to more schools over the span of four school years, starting with schools with the greatest need. As part of the initiative, all juniors and seniors were expected to receive at least one individual college and career advising session per year to create a documented plan for their time after high school, which could include additional education or other career goals. NYCPS provided schools with a data infrastructure that they could use to track and monitor students' progress in reaching five milestones within their plan, though schools varied in the extent to which they took advantage of this resource. To support this work, NYCPS provided schools with additional funding, as well as professional learning opportunities and coaching specifically focused on providing high-quality college and career advising and resources such as guides and scripts to use during advising conversations.

Dual Enrollment

NYCPS students in most high schools have the opportunity to enroll in college courses and earn up to 15 college credits through CUNY's College Now program. More than 400 high schools partner with a CUNY campus to offer at least some college courses at the high school, or to allow high school students to take classes on the college campus. The program is free of charge to students, and covers all associated costs such as textbooks. While some high schools or colleges may have additional eligibility requirements, generally students must be either juniors or seniors and meet college-readiness benchmarks, such as sufficient Regents scores, that are similar to the requirements in P-TECH 9-14 schools for enrolling in college-credit courses. Each college campus has designated College Now staff members who help students as they take college courses. Unlike P-TECH 9-14 schools, which have their own, designated college counselors or liaisons, College Now staff members typically work with multiple high schools at a time.[4]

4. Britton, Chelliah, Symns, and Campbell (2019).

Finally, the CUNY Early College Initiative oversees 10 other early college high schools throughout the city beyond the P-TECH 9-14 schools. [5] These schools differ from the P-TECH 9-14 model in that they educate students in grades 6-12, 9-12, and 9-13; offer a general liberal arts curriculum rather than a career path focused on science, technology, engineering, or math; and do not necessarily have an employer partner.[6]

STUDENT, PARENT, AND TEACHER PERSPECTIVES ON P-TECH 9-14 SCHOOLS AND OTHER SCHOOLS

While it is important to understand the broader context of NYCPS's approaches and initiatives regarding career and college, it is also important to explore the individual experiences of students, parents, and teachers in both the P-TECH 9-14 sample and the comparison schools. Every year, NYCPS conducts a School Climate Survey that asks students, parents, and teachers about their perspectives on their schools. One way to gauge differences between P-TECH 9-14 students and students in the comparison group is by comparing the survey responses of the two groups. Specifically, the analysis that follows looks at responses to questions related to the overall school environment and then questions that focus on college and career, as these are domains where P-TECH 9-14 schools are likely to differ most from other schools. This analysis focuses on school climate during the average sample student's expected fourth year of high school. The surveys include responses from P-TECH 9-14 students and comparison group students (the "analysis sample") who were enrolled in the spring semesters of 2017, 2018, and 2019; parents of students enrolled in those semesters; and teachers teaching in schools with enrolled sample students during those semesters.

There is variability in response rates across years.[7] In the student and parent surveys, survey nonrespondents differed from respondents in areas such as special education status or educational achievement; this difference may mean that the surveys are not representative of the full sample. The survey findings presented here nonetheless help to put the study's impact findings in context, with a focus on the findings from the teacher survey, which had the highest response rate.

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5. As described elsewhere in this report, P-TECH 9-14 students receive access to college courses while in high school through the CUNY Early College Initiative.
6. City University of New York, "Early College Initiative" (n.d.); City University of New York Early College (n.d.).
7. Response rates for the surveys ranged from 81 percent to 83 percent for the student survey, 52 percent to 53 percent for the parent survey, and 80 percent to 81 percent for the teacher survey during those years. Match rates, which are determined by matching survey response rates to individuals in the analytic sample and incorporate underlying survey response rates, were 56 percent to 73 percent for the student survey, 27 percent to 39 percent for the parent survey, and 99 percent for the teacher survey. Details on the methodology behind these rates are included in Appendix A and impact results are in Appendix Tables A.21-A.23.

Overall School Environment

Teachers of P-TECH 9-14 students reported overall higher school quality in areas such as academic expectations, safety, and student feelings of inclusion in the school community, and reported a more respectful and trusting school environment than did teachers of comparison group students. Teachers of students in P-TECH 9-14 schools also rated their principal's leadership more highly and reported higher levels of adult support for students than did teachers of students in the comparison group. All P-TECH 9-14 schools are considered small schools in New York City, while the students in the comparison groups attended schools of varying sizes.[8] Other studies of small schools in NYCPS have found that that principals and teachers believe that personal relationships, academic expectations, teacher talent and commitment, and school leadership are what make their schools effective, and that strong school leadership in particular leads to impacts on student outcomes.[9] This perception of quality linked to size could, therefore, help explain the difference between teachers at P-TECH 9-14 schools and teachers of students in comparison schools in their views of leadership and feelings of support.

Parents of P-TECH 9-14 students also viewed the environment, quality, and leadership of their children's schools more favorably than did parents of students in the comparison group. However, parents of P-TECH 9-14 students with Individualized Education Programs (IEPs) reported lower levels of satisfaction with IEP development and management at their children's schools than did parents of students with IEPs in the comparison group. Students in the P-TECH 9-14 and comparison groups had similar survey responses when it came to questions on the school environment.

Support for College and Career Planning

Although teachers of P-TECH 9-14 students reported their schools had higher-quality environments overall, there was not a statistically significant difference in the amount of postsecondary counseling they said was available to students, compared with teachers of comparison group students. There were no differences between the groups in what students or parents of students reported about support from adults in the school for college and career planning, nor in what they reported about postsecondary counseling. The lack of difference reported may be due to the increased focus on career and college planning across NYCPS discussed above, or because, unlike teachers who may have worked in multiple schools, student and parent respondents may lack knowledge of what other schools offer.

8. Small schools in New York City have approximately 100 to 125 students per ninth-grade class.
9. Villavicencio and Marinell (2014); Bloom, Unterman, Zhu, and Reardon (2020).

DISCUSSION

Recent efforts at the district and city level to increase awareness of and access to college and work-based learning opportunities for students in many kinds of high school may mean that the differences in experiences for students enrolled in typical New York City high schools compared with P-TECH 9-14 schools may have lessened over time. That said, because these initiatives require extensive resources, many were expanded slowly or targeted specific types of public schools (for example, community schools) and it is difficult to ascertain the extent to which comparison group students experienced these programs. Regardless, it appears that these initiatives and activities are not as intensive as those found in P-TECH 9-14 schools, and may not be as deeply embedded in the school culture as the experiences that P-TECH 9-14 are exposed to.

While parents and teachers of P-TECH 9-14 students reported more satisfaction with their schools' environments than did parents and teachers of comparison group students, there was not a significant difference reported by students, parents, or teachers regarding postsecondary planning. This similarity may reflect the fact that other schools are also focusing on providing postsecondary planning support to students and families. It may also reflect the fact the P-TECH 9-14 students and families have high expectations for postsecondary planning from the school because the schools are so focused on career and college preparation throughout students' time at the school. However, this lack of contrast does not detract from the fact that many surveyed groups view the school quality and environment of P-TECH 9-14 schools more favorably than their counterparts at non-P-TECH 9-14 schools view their own schools.

4

Impacts

This chapter examines the impact of the P-TECH 9-14 schools on student outcomes. A previous report presented evidence of positive impacts on high school outcomes through the first three years of high school.[1] The previous brief on dual enrollment presented four years of high school outcomes, but only for some entering classes (cohorts) of students.[2] This report provides impacts for students in all cohorts, for all high school measures, through four years of high school. It also includes findings for Years 1-3 of postsecondary education, for cohorts who can be followed to each of those milestone years.

The present analyses include multiple cohorts of students who began ninth grade between 2013 and 2017. They also include students who were assigned to enroll in all seven of the P-TECH 9-14 schools in this study, even as those schools opened at different times (see Table 4.1 for which cohorts are followed to outcomes in which school years). Results are presented for the full sample of students and for subgroups defined in two ways.

The first pair of subgroups analyzed are those students who were enrolled in four years of high school before the educational disruptions caused by the COVID-19 pandemic and those whose high school careers were disrupted by it in some way. The report refers to these subgroups as the "pre-COVID" and "COVID-affected" subgroups. Specifically, the cohorts that began ninth grade in 2013, 2014, and 2015 are considered "pre-COVID" because they were expected to complete four years of high school by the spring of 2019, before the pandemic began. Those cohorts starting ninth grade in 2016 and 2017 are considered "COVID-affected" because they would have been in high school in the spring of 2020, when New York City schools closed and then reopened on a hybrid schedule for the 2020-2021 school year. This split between cohorts is maintained when looking at all high school impacts. These analyses of the high school years and outcomes affected and unaffected by COVID is an attempt to provide evidence about how the P-TECH 9-14 model influenced high school outcomes absent, and in the presence of, the pandemic disruptions. However, all the cohorts that could be followed to postsecondary education faced the changes that the pandemic wrought on

1. Rosen et al. (2020).

2. Dixon and Rosen (2022).

Table 4.1

P-TECH 9-14 Schools and Cohorts Included in the Analytic Samples

	Number of Students in the Analytic Sample								Analytic Cohorts				
										COVID groups			
9th-Grade Year	School 1	School 2	School 3	School 4	School 5	School 6	School 7	Total	Year 4 Results	Pre-COVID High School Cohorts	COVID-Affected High School Cohorts	Post-secondary Year 1 Results	Post-secondary Year 2 Results
2013-2014	13							13	2016-2017			2017-2018	2018-2019
2014-2015[a]	194	130	154					478	2017-2018			2018-2019	2019-2020
2015-2016[a]	268	179	36	99	121	9		712	2018-2019			2019-2020	2020-2021
2016-2017	183	169	117	117	112	45	218	961	2019-2020			2020-2021	
2017-2018	248	141	121	112	171	21	183	997	2020-2021				
Total	906	619	428	328	404	75	401	3,161					

NOTE: [a]Included in the cost study.

the postsecondary experience by the time they reached postsecondary Years 1 and 2.[3] For this reason, the analysis of "pre-COVID" and "COVID-affected" subgroup impacts does not examine postsecondary outcomes.

That said, the mix of schools within these groups also differs somewhat. Specifically, beginning in 2015 the full sample includes students who applied to and were assigned to three newer schools that started after the initial three schools the city opened.[4] As described in Chapter 2, some of these schools approached dual enrollment and the affiliated associate's degree in different ways than did some of the earlier schools. It is not possible to entirely disentangle the effects of the pandemic from the effects of newer school openings, as is illustrated in Table 4.1.[5] However, a stable sample analysis, where all outcomes are analyzed for the cohorts that can be followed for six years, is provided in the appendix to show the impacts over time for that smaller sample of students who started in those first three schools. Graduation and postsecondary impacts for this group mirror the findings for the full sample that are presented in this chapter.

The chapter also presents findings for male and female students. Earlier findings on the impact of P-TECH 9-14 on dual enrollment presented in a previous brief found stronger dual-enrollment rates for young women than for young men (that is, higher percentages of young women than young men enrolled in any college-level courses while in high school), with the average female student dual-enrollment rate exceeding the average male dual-enrollment rate by almost 10 percentage points.[6] Given the differences between male and female engagement in dual enrollment, impacts in this report are presented for all outcomes by gender.[7] As discussed in the previous brief, it should be noted that while 21 percent of the sample was designated as needing special education services at some point before they applied to high schools in eighth grade, 78 percent of those students were male, so some of the gender differences may be partially explained by special education status. However, similar patterns as those reported below were found when comparing the gender subgroups for only those students without special-education status; this analysis can be found in Appendix Table A.17.

3. The 2013 cohort was expected to reach the end of the six-year P-TECH 9-14 experience in the 2018-2019 school year, however it is too small on its own to provide reliable analysis.
4. The seventh P-TECH 9-14 school opened in 2016.
5. It is important to note that these newer schools opened several years before the first of their students are included in the analytic sample. The first year that schools are included in the sample is the first year for which there was enough oversubscription—that is, that they had become popular enough to have more applicants than seats, triggering a lottery admission for some seats.
6. Dixon and Rosen (2022).
7. While the distribution of students by gender differs across schools, with some schools skewing more male or more female, the analysis includes school level fixed-effects to control for between-school differences. In addition, the study team analyzed all outcomes by individual schools, and found that most of the gender patterns described in the findings hold across schools. For more on this issue, please refer to Appendix A.

This chapter begins by providing impacts on the outcomes associated with three of the opportunities offered to students described in the logic model in the introductory chapter (Figure 1.1). These components are measured to gauge specific differences between the P-TECH 9-14 group and the comparison group with respect to some of the experiences that serve as hallmarks of these schools. including engagement in career and technical education (CTE), opportunities to participate in internships, and dual enrollment. The chapter also provides impacts on measures of educational achievement, including high school credit accumulation after four years, high school graduation, and three years of postsecondary enrollment and degree attainment.

Findings:

Overall, the chapter provides evidence that:

1. Students in the P-TECH 9-14 group participated in internships at much higher rates than students in the comparison group.

2. Students in the P-TECH 9-14 group were 26 percentage points more likely to enroll in a college-level course during high school.

3. There was no difference in four-year high school graduation rates between groups.

4. There were large impacts on having an internship during high school for students in both the pre-COVID and COVID-affected subgroups. Among students in the P-TECH 9-14 group, 61 percent of students in the pre-COVID cohorts engaged in internships during high school, compared with almost 45 percent of students in the COVID-affected cohorts. In both time periods, only about 14 percent of comparison group students engaged in internships.

5. Among students in the P-TECH 9-14 group, students in the pre-COVID cohorts earned an average of seven college credits while in high school, while students in the COVID-affected cohorts earned five. In both time periods, comparison group students earned about one college credit while in high school.

6. There were large differences between young men and women in postsecondary educational attainment. Seven years after they entered high school, 13 percent of male students in the P-TECH 9-14 group and almost 3 percent of male students in the comparison group had earned a college degree. In contrast, 14 percent of female students in the P-TECH 9-14 group and 13 percent of female students in the comparison group had earned a college degree.

ABOUT THIS STUDY

To help the reader understand the analyses presented in this report and to describe the population of students for whom the findings are relevant, this section provides an overview of the New York City high school admissions process, a description of the sample of students, an outline of the cohorts of students for whom outcomes are measured, and an explanation of how to interpret impact findings.

Overview of the High School Admissions Process

In New York City, eighth-grade students apply to high schools through a centralized system. Students are allowed to rank up to 12 schools they are interested in attending. An algorithm assigns students random numbers and matches them to schools based on whether they meet the admissions criteria for a given school and the order of preference listed by the student. In some cases, when more students meet a school's admissions priority categories than there are available seats in that school, a process similar to a lottery occurs in which some students are randomly offered admission to a particular school, while other students randomly are not offered the opportunity to attend the school. This random lottery process for allocating seats is akin to a random assignment study, in which two comparable groups are created. In this report, the group that received an offer of admission to a P-TECH 9-14 school is referred to as the P-TECH 9-14 group, while those who were not offered a seat in one of the schools are referred to as the comparison group. During the admissions years covered by this study, all seven P-TECH 9-14 schools were oversubscribed at least once, meaning there were random lotteries for at least a subset of seats in each of the schools for every year they are included in the analysis. As described in detail in the first report in this series, not all students who enrolled in P-TECH 9-14 schools were admitted through a lottery process.[8] Those who were admitted through a lottery and who are included in the analytic sample scored lower on eighth-grade tests of math and English language arts than did other students who enrolled in these schools, so the findings from this study are applicable to a group of students who were performing worse than average at the beginning of high school.

In addition, while the students in the P-TECH 9-14 group were concentrated in the seven P-TECH 9-14 schools, those students who were not offered a seat in one of these schools (the comparison group) ended up receiving admissions offers from a total of 399 other high schools across New York City — which is almost all other high schools in the city. The comparison group can therefore be thought of as "students who experienced any non-P-TECH 9-14 school in New York City." This comparison is a very broad one, representing a wide range of high school experiences.

Sample

The seven P-TECH 9-14 schools in this study opened between 2011 and 2016. The analytic sample includes ninth-grade cohorts of students who were offered admissions to the schools between 2013 and 2017, the years for which it was possible to identify admissions lotteries

8. Rosen et al. (2020).

for the schools.[9] Because of the staggered nature of school openings, this report includes students in cohorts who could be followed for between four and seven years, beginning with their ninth-grade year. As the follow-up period becomes longer, the sample of students who can be followed to different milestones shrinks. To maximize the sample size for the analyses, the impact findings for any given follow-up year are based on all students whose outcomes could be measured that year.[10] This decision means that results for a given year, such as the second year of postsecondary education, cannot be interpreted as flowing from the previous year. In other words, the sample of students for whom there are two years of postsecondary outcomes is not identical to the sample of students for whom there is one year of postsecondary outcomes. Rather, each year of outcomes should be interpreted cross-sectionally, as only applicable to that group of students, and not longitudinally, as if the same students were followed from year to year.[11] The cohorts who are included and followed to specific outcomes are illustrated in Table 4.1.

The students who applied to P-TECH 9-14 schools were predominantly Black and Hispanic and came from families who lived in U.S. Census tracts where the median household income was approximately $15,000 a year lower than the citywide average median income of $57,000, for the years these students were in eighth grade (2012-2016).[12] More than 70 percent of the sample had eighth-grade math and English language arts (ELA) scores that did not meet grade-level standards. Additionally, approximately 10 percent of the sample were classified as English Language Learners in eighth grade.

Importantly, when they entered the study, before the high school admissions lottery, the two groups were not different to a statistically significant degree across most demographic characteristics, as illustrated in Table 4.2. This similarity is an important empirical indicator that the lottery functioned appropriately and increases the likelihood that later differences in the outcomes of students in the two groups were caused by the offer of a seat at a P-TECH 9-14 school.

Because not all students in P-TECH 9-14 schools are offered seats through the lottery, this study included an analysis comparing the characteristics of students who were offered seats in a P-TECH 9-14 school with and without a lottery. This analysis helps illuminate how generally representative the study's results are. As mentioned above, students in the analytic sample — those admitted by lottery — were more likely to have been classified as English Language Learners and had lower math and ELA test scores in eighth grade than students

9. No lotteries were included for schools in their first year of operation, because it is not clear whether students in those years had enough information to know they were applying to a P-TECH 9-14 school.

10. As mentioned above, to confirm that the pattern of effects across years is not confounded with changes in the student and school sample, impacts were also examined for the subsample of "stable" students in each year across all three follow-up years. These results are in the Appendix A.

11. To provide more information on cohort-by-cohort outcomes, Appendix A also contains some outcomes analyzed for specific cohorts.

12. Data on citywide median income and median incomes for U.S. Census tracts come from the U.S. Census Bureau.

Table 4.2

Baseline Characteristics of the P-TECH 9-14 Analytic Sample

Characteristic	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference
Race/ethnicity (%)						
Hispanic	44.8	47.3	-2.6		-0.05	0.150
Black	40.2	39.6	0.6		0.01	0.720
White	4.7	3.9	0.8		0.05	0.271
Asian	8.6	7.7	0.9		0.04	0.369
Other	1.7	1.5	0.2		0.02	0.689
Female (%)	37.7	42.2	-4.5	**	-0.09	0.013
Median household income[a]	-0.5	-0.5	0.0		-0.01	0.849
Missing median household income (%)	2.6	2.4	0.2		0.01	0.807
8th-grade ELA test performance level[b]						
Did not meet standards (level 1) (%)	26.1	24.5	1.6		0.04	0.339
Partially met standards (level 2) (%)	44.8	43.7	1.0		0.02	0.618
Fully met standards (level 3) (%)	21.6	23.0	-1.4		-0.03	0.385
Met standards with distinction (level 4) (%)	4.1	4.5	-0.4		-0.02	0.598
Missing test information (%)	3.5	4.3	-0.8		-0.04	0.315
8th-grade math test performance level[b]						
Did not meet standards (level 1) (%)	36.9	36.9	0.1		0.00	0.977
Partially met standards (level 2) (%)	35.1	35.2	-0.1		0.00	0.966
Fully met standards (level 3) (%)	11.7	11.7	0.0		0.00	0.993
Met standards with distinction (level 4) (%)	3.2	4.1	-0.8		-0.05	0.255
Missing test information (%)	13.0	12.2	0.9		0.03	0.541
Flagged as an English Language Learner (%)	10.3	9.9	0.4		0.01	0.752
Missing English Language Learner status (%)	6.6	6.0	0.7		0.03	0.481
Enrolled in a charter school in the spring of 8th grade (%)	8.1	8.0	0.2		0.01	0.889
Sample size (total = 3,161)	1,479	1,682				
Number of lotteries (total = 42)						

(continued)

Table 4.2 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between P-TECH 9-14 group members and comparison group members are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for lottery winners and comparison group members. The value for comparison group members equals the corresponding value for P-TECH lottery winners minus the estimated difference between lottery winners and comparison group members. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between P-TECH 9-14 and comparison group members.

An F test was used to assess the statistical significance of the overall difference between lottery winners and control group members reflected by the full set of baseline characteristics in the table. The resulting p-value value is not statistically significant (p-value = 0.206).

[a]Median household income has been z-scored to standardize across census tract and cohort year.

[b]Students scoring at proficiency levels 1 and 2 are not considered to be performing at grade level for state math and reading exams. Due to missing test scores, the sum of levels 1 through 4 may not add to 100 percent.

admitted to the P-TECH 9-14 schools without a lottery but were no more or less likely to be special education students. Thus, the results of this study are most applicable to those students — usually with lower test scores — who were offered seats in P-TECH 9-14 schools by lottery. Although it may not be possible to extrapolate the results to all students enrolled in P-TECH 9-14 schools in New York City, the results do address the impacts of these schools for students who had lower eighth-grade test scores than some of their peers — a group of students whose outcomes are typically important to policymakers.

Interpreting the Results

The primary estimates presented in this report are what are known as “intention-to-treat” estimates. For this type of estimate, the P-TECH 9-14 and comparison groups are made up of all students who were assigned to either group by the lottery, whether or not they actually enrolled in a P-TECH 9-14 high school. Findings from this kind of analyses are considered the *causal* estimates because the groups are comparable. The groups differ only in having been offered a seat or not, allowing researchers to determine that the intervention, in this case the offer to attend a P-TECH 9-14 school, caused any differences reported between groups. These results are policy-relevant because they represent the best estimates of what can be expected to occur, on average, in a community of students when a school or set of schools is opened and made available to them, rather than estimates of the average effects of student enrollment in the program.

IMPACTS ON HIGH SCHOOL OUTCOMES[13]

Differences in Participation in CTE, Internships, and Dual Enrollment

Three of the defining features of P-TECH 9-14 schools are increased CTE coursework, increased access to internships, and increased access to dual enrollment. Combined, these program components provide substantive differences between the educational experiences offered to P-TECH 9-14 students and those they may have otherwise received, had they enrolled in other kinds of high schools. This section discusses whether there were observed differences in student participation in these three activities between students in the P-TECH 9-14 and comparison groups.

Impacts for the Full Sample

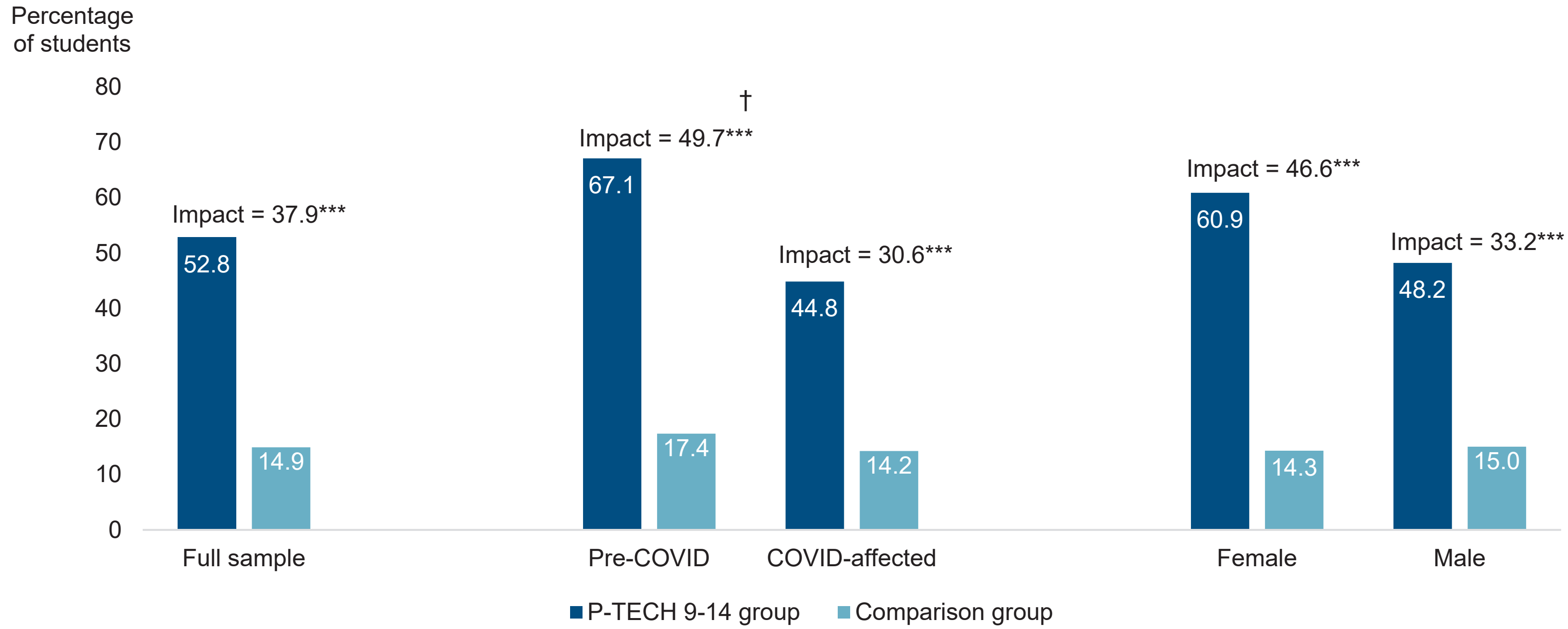
There were notable differences between the P-TECH 9-14 group and the comparison group in the number of high school CTE credits they earned. At the end of four years of high school, on average, students in the P-TECH 9-14 group earned two more credits in CTE than their comparison group counterparts, a statistically significant difference (as shown in Appendix Table A.2). Because one credit is given per semester-long class in the New York City system, this impact is the equivalent of one more year of CTE for students in the P-TECH 9-14 group.[14] As illustrated in Figure 4.1, students in the P-TECH 9-14 group were also 38 percentage points more likely to have had an internship during four years of high school than students in the comparison group, a difference that is statistically significant.[15] By the end of four years of high school, 46 percent of students in the P-TECH 9-14 group had attempted at least one dual-enrollment course, compared with 20 percent of students in the comparison group, a statistically significant difference of 26 percentage points (as also shown in Appendix Table A.2). As shown in Figure 4.2, students in the P-TECH 9-14 group earned an average of six college-level credits, compared with an average of 1.5 earned by comparison group students. Most college courses are three credits, meaning that the average student in the P-TECH 9-14 group completed two college courses before the end of high school, compared with an average of a half a college course among comparison group students.

13. Because this study design uses a natural experiment based on a student lottery, results should be interpreted at the student level. That is, the estimates presented here are the average impact for the average student who applied to any P-TECH 9-14 school and who was admitted in the first lottery between 2013-2017. The full analytic sample includes 3,161 students, but lotteries for some schools were larger than others, and students were not evenly distributed across all seven schools.

14. Full results for these impacts can be found in Appendix Table A.2.

15. Data combine paid internships and internships for credits. Data that separate the two in distinct ways were unavailable. Data on internships also do not include those offered through the Summer Youth Employment Program, and thus may understate the proportion of students who actually participated in internships.

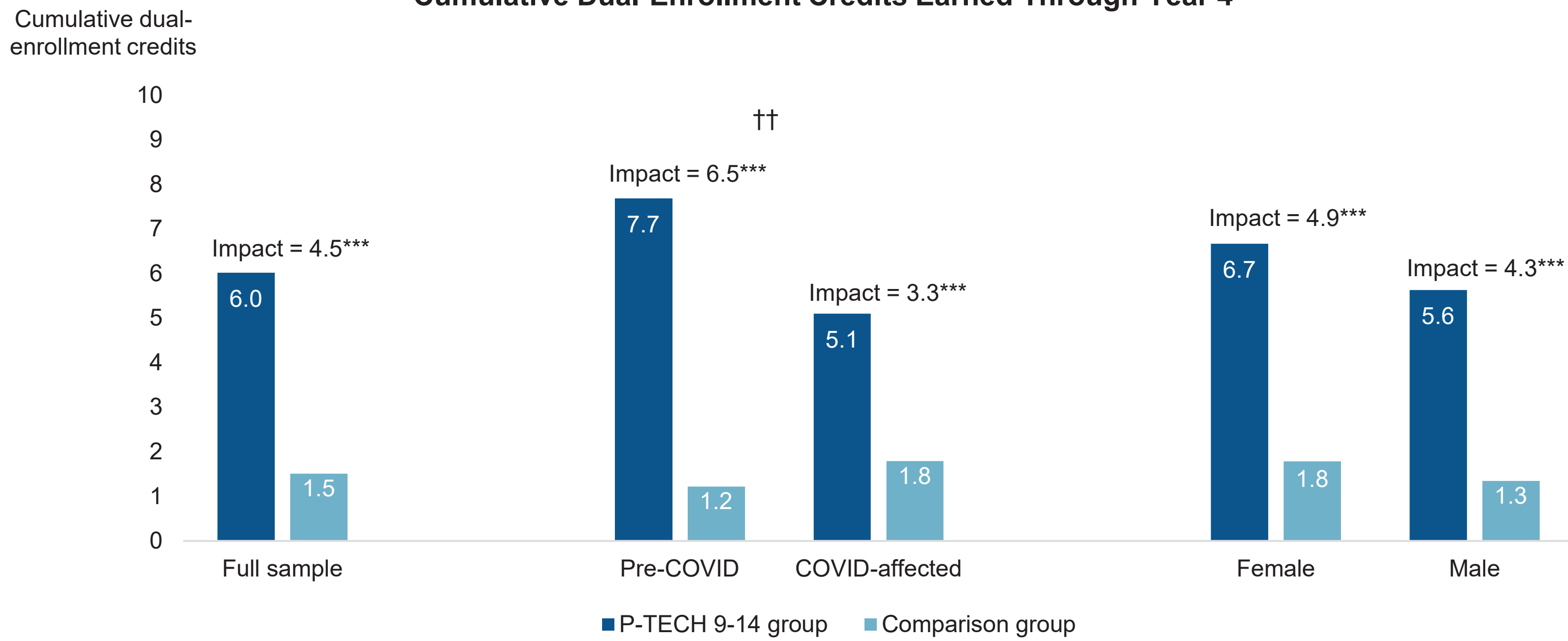
Figure 4.1
Percentage of Students with Any Internship by the End of Year 4



SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between P-TECH 9-14 group and comparison group members and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Figure 4.2
Cumulative Dual-Enrollment Credits Earned Through Year 4



SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between P-TECH 9-14 group and comparison group members and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Impacts by COVID Experience

Among pre-COVID cohorts, the impact on CTE credit attainment was slightly larger than it was for the full sample, with students in the P-TECH 9-14 group earning, on average, three more CTE credits than their comparison group counterparts. For COVID-affected cohorts, the impact was slightly smaller, at 1.6 credits' difference between the groups.[16] These impacts are equivalent to one and a half years of CTE coursework for the earlier cohorts, and less than a full academic year's worth for the latter group. The impacts are statistically significant for both subgroups; the difference between the impacts is not statistically significant. In both scenarios, the difference between the P-TECH 9-14 group and the comparison group represents a meaningful amount of CTE coursework.

Pre-COVID cohorts engaged in internships at higher rates than the COVID-affected cohorts, who saw school closures, hybrid scheduling, or both during their high school careers. Among the pre-COVID cohorts, 67 percent of students in the P-TECH 9-14 group had an internship during high school compared with 17 percent of comparison group students, a statistically significant 50 percentage point difference. Among the COVID-affected cohorts, 45 percent of students in the P-TECH 9-14 group had an internship during high school compared with 14 percent of the comparison group, a statistically significant 31 percentage point difference. The difference in impacts between the pre-COVID and COVID-affected subgroups is statistically significant. The P-TECH 9-14 group saw less engagement in internships during the COVID-affected years as it became harder for schools to coordinate those internship experiences, as noted in the implementation chapter. Nonetheless, for both time periods, the differences between the P-TECH 9-14 and comparison groups are large and highly significant.

There was a larger impact on dual enrollment for students in the pre-COVID cohorts, compared with those in the COVID-affected cohorts. For pre-COVID cohorts, 50 percent of students in the P-TECH 9-14 group enrolled in any college-level courses during high school compared with 20 percent of the comparison group, a statistically significant 30 percentage point difference. This impact was 24 percentage points for COVID-affected cohorts, though that impact is still statistically significant and the difference in impacts between subgroups is not statistically significant. However, among the pre-COVID cohorts, students in the P-TECH 9-14 group earned nearly eight college credits while in high school, which is more than two average college classes, while among the COVID-affected cohorts they earned an average of five. In both time periods, the comparison group earned about one college credit. The difference in impacts on credit accumulation between the subgroups is statistically significant.

Impacts by Gender

By the end of high school, female students in the P-TECH 9-14 group had earned an average of 10 CTE credits, compared with 5 for female students in the comparison group, for a statistically significant difference of 4 CTE credits.[17] In contrast, male students in the P-TECH 9-14 group earned an average of 7 CTE credits, compared with 6 CTE credits earned by their

16. Full results for these impacts can be found in Appendix Table A.2.

17. The apparent discrepancy in this difference is due to rounding.

male comparison group counterparts. That difference, however, is statistically significant.[18] The difference in impacts between male and female students is also statistically significant. These impacts are the equivalent of an average of two more years of CTE coursework for female students in the P-TECH 9-14 group, and an average of one extra semester of CTE coursework for male students in the P-TECH 9-14 group, compared with students in the comparison group.

There were also notable effects by gender in internship experiences. About 61 percent of female students in the P-TECH 9-14 group engaged in internships during high school, compared with 14 percent of female comparison group students. The level of internship participation for male students in the P-TECH 9-14 group was 48 percent, compared with 15 percent for male comparison group students. The differences between the P-TECH 9-14 and comparison groups in both gender subgroups are statistically significant; the difference in impacts between the subgroups is not statistically significant.

Almost 53 percent of female students in the P-TECH 9-14 group enrolled in at least one college-level course while in high school, compared with 25 percent of female comparison group students. In contrast, 42 percent of male students in the P-TECH 9-14 group enrolled in at least one college-level course during high school, compared with almost 17 percent of male comparison group students. The size of these impacts within gender subgroups is similar (27 percentage points and 25 percentage points, respectively). However, it is notable that in both groups the male students were less likely to enroll in any college-level courses while in high school, with male comparison group students doing so at the lowest rate. The pattern looks much the same for total college credits earned while in high school, as shown in Figure 4.2.

Differences in High School Credit Accumulation and Graduation

The research team analyzed impacts on two additional sets of high school outcomes: high school credit accumulation and high school graduation rates.

Impacts for the Full Sample

As noted above, students in the P-TECH 9-14 group earned more CTE credits than did students in the comparison group. These CTE credits did appear to come at a small cost to academic credits.[19] Students in the P-TECH 9-14 group earned, on average, one credit less in academic subjects than comparison group students (the equivalent of a one-semester course), and this result is also statistically significant.[20] However, it is not clear what specific academic areas students in the P-TECH 9-14 group earned fewer credits in, or whether an

18. Full results for these impacts can be found in Appendix Table A.2.

19. Academic credits refer to those earned in core academic subjects including math, ELA, science, social studies, and foreign languages.

20. Full results for these impacts can be found in Appendix Table A.3.

academic reduction of a one-semester course is a substantive or meaningful decrease in overall educational value.

By the end of four years of high school, there was not a statistically significant difference in total high school credits earned between students in the P-TECH 9-14 group and those in the comparison group. Both groups earned around an average of 40 high school credits, or an average of five full-year courses per year in four years.[21] At the end of four years, close to 65 percent both the P-TECH 9-14 and comparison groups graduated high school.[22] This level rose to close to 70 percent for both groups at five years, and to 75 percent at six.

The cohorts in this sample reached the end of four years of high school between 2017 and 2021. During this same period, the average four-year graduation rate citywide ranged from 74 percent in 2017 to 79 percent in 2020, the last available year of data published by New York State.[23] The students in both the P-TECH 9-14 and comparison groups, who entered high school with lower-than-average eighth-grade math and ELA test scores, had lower four-year high school graduation rates than their peers citywide.

Impacts by COVID Experience

Among students in the pre-COVID cohorts — who were able to complete all four years of high school before pandemic disruptions — students in the P-TECH 9-14 group earned an average of two more high school credits, or a one-year course's worth, in four years than students in the comparison group. However, this difference reflects the additional CTE credits earned by the P-TECH 9-14 group. There was not a statistically significant difference in academic credits between the P-TECH 9-14 group and the comparison group. For students in the COVID-affected cohorts — who were enrolled in their fourth and third years of high school during COVID — there was no statistically significant difference in the total high school credits earned between the P-TECH 9-14 and comparison groups. This change from the pre-COVID cohorts reflects a decline in CTE credits earned by the P-TECH 9-14 group, on average. There was virtually no change in the average number of academic credits earned by either the P-TECH 9-14 or the comparison group. However, this difference in impacts between subgroups on total credits earned is not statistically significant. There were no statistically significant differences between the P-TECH 9-14 group and the comparison group in high school graduation rates for the pre-COVID or COVID-affected cohorts, and there was no difference in impacts between the subgroups.

21. The number of credits required to graduate high school in New York City is 44. Because the analytic sample includes all students who were offered seats in P-TECH 9-14 schools, it includes students who may have never accepted the offer to enroll, as well as those who left public high schools in New York City before the end of four years. For this reason, the average number of credits may appear lower than the number of credits required to graduate. More details on the methodology can be found in Appendix A.

22. An additional analysis of "compliers"—those who accepted the ninth-grade enrollment offer they were given—found that 72 percent of those who actually enrolled in a P-TECH 9-14 school in ninth grade graduated high school within four years. More on these complier estimates can be found in Appendix A.

23. New York State Education Department (2021).

Impacts by Gender

The only observed positive impacts on high school credit accumulation are among female students. Female students in the P-TECH 9-14 group earned an average of 2.4 additional total high school credits more than their comparison group counterparts, and that difference is statistically significant. Female students in the P-TECH 9-14 group were also largely responsible for the slight negative impact on academic credits earned described for the full sample, earning an average of 1.6 fewer academic credits than female students in the comparison group. Among male students, there were no significant differences between the P-TECH 9-14 and comparison groups in academic or total credits earned. However, female students in both the P-TECH 9-14 and comparison groups earned more total credits than their male peers, and the difference between genders in impacts on credit accumulation is not statistically significant. There were no statistically significant differences between genders in impacts on graduation rates.

IMPACTS ON POSTSECONDARY OUTCOMES

The research team analyzed impacts on postsecondary enrollment in two- and four-year colleges, as well as postsecondary degree attainment in each of the fifth, sixth, and seventh years after high school enrollment. The measures analyzed for each year include outcomes that combine either being enrolled at or earning a degree from a two- or four-year college by the end of one, two, and three years of postsecondary education. Both continuing to be enrolled and attaining a degree by the end of each time period is viewed as a successful outcome, with the comparison being neither enrolled in school nor holding a postsecondary degree. From here on, this measure will be referred to as "enrolled" for brevity. In addition, a measure of degrees earned by the end of the relevant time period is analyzed separately, as a stand-alone outcome.[24]

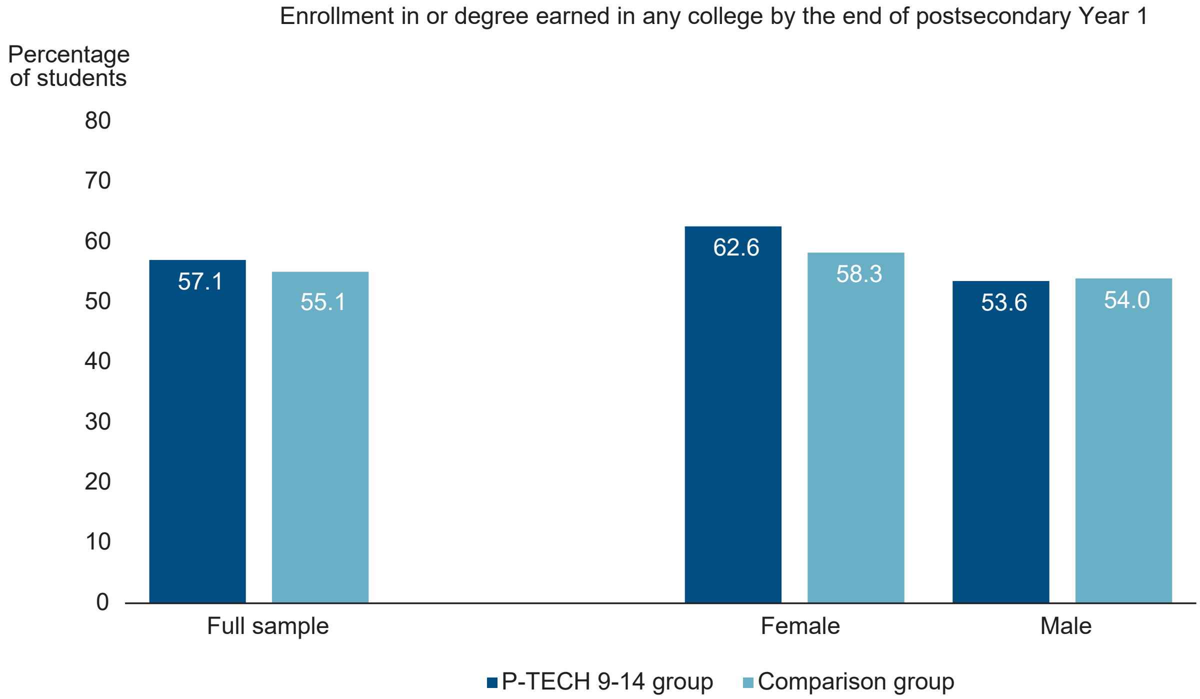
One Year of Postsecondary Education: Enrollment and Degrees

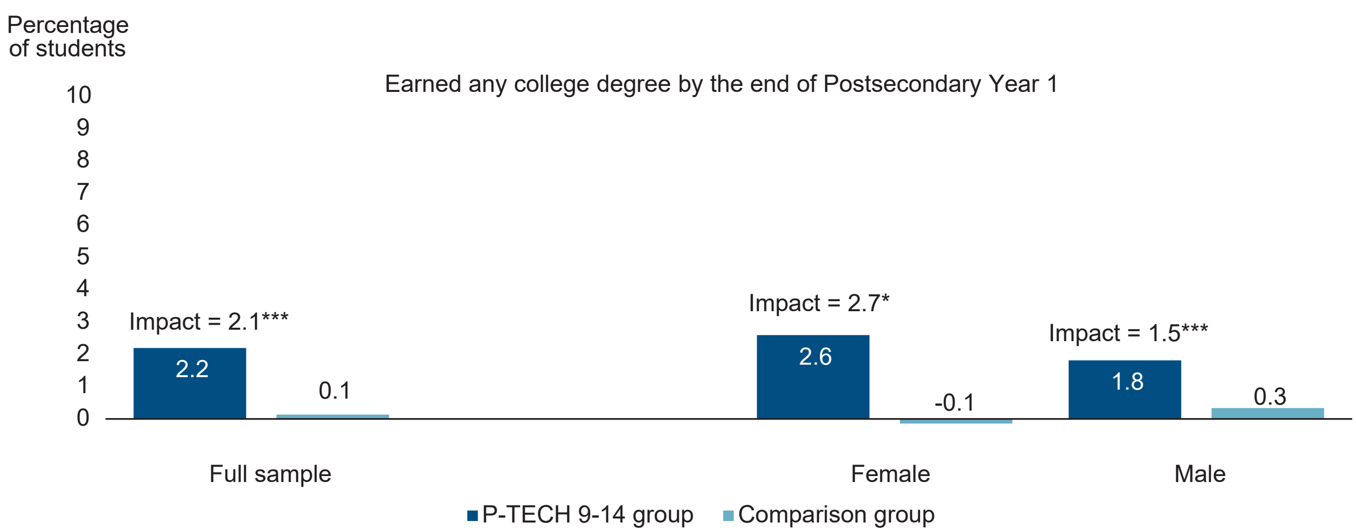
Impacts for the Full Sample

As seen in Figure 4.3, in the first postsecondary education year after expected four-year high school graduation, 57 percent of the P-TECH 9-14 group and 55 percent of the comparison group was enrolled in college, a difference that is not statistically significant. However, 5 percentage points more of the P-TECH 9-14 group was enrolled in a two-year college during that year (as shown in Appendix Table A.4). This finding indicates that students in the P-TECH 9-14 group were more likely than the comparison group to choose two-year colleges rather than four-year colleges. One possible unintended consequence of the P-TECH 9-14 model is

24. Almost all degrees earned were associate's degrees. By the end of the first postsecondary year, one student in the P-TECH 9-14 group had completed a four-year degree. By the end of the second postsecondary year, two students in the P-TECH 9-14 group had earned four-year degrees. By the end of the third postsecondary year, four students in the P-TECH 9-14 group and two comparison group students had earned four-year degrees.

Figure 4.3
Any College Enrollment and Degree Attainment in Postsecondary Year 1





SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between P-TECH 9-14 group and comparison group members and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

that its dual enrollment and free associate's degree aspects may encourage students who would qualify for four-year colleges to choose two-year colleges instead, as has been found recently in some other settings with intensive dual enrollment.[25]

Remarkably, some students completed a college degree one year after their expected high school graduation: 2 percent of the students in the P-TECH 9-14 group had earned a college degree five years after entering high school, compared with less than 1 percent of the comparison group, a statistically significant difference. While the absolute percentage of students who earned degrees by this point may seem small, this finding is worth exploring because it is so early. In fact, research on community colleges rarely measures degree attainment at the one-year mark because so few people complete degrees so quickly. It is perhaps especially remarkable given that the students in the P-TECH 9-14 group entered ninth grade performing below average. This population of students is not one who would typically be expected to complete college early.

Impacts by Gender

In the first year of postsecondary education, female students in both the P-TECH 9-14 and comparison groups enrolled in college at higher rates than male students. While about 54 percent of male students from both groups enrolled in college, almost 63 percent of female students in the P-TECH 9-14 group and almost 58 percent of female students in the comparison group enrolled in college at the same time. While the difference among female students between the P-TECH 9-14 group and the comparison group is not statistically significant, female students in the P-TECH 9-14 group were significantly more likely to enroll in two-year colleges. Almost 32 percent of the female students in the P-TECH 9-14 group chose two-year colleges, compared with 21 percent of female students in the comparison group. There was not a significant difference among female students in four-year college enrollment between the P-TECH 9-14 and comparison group. Among male students, there were no differences between groups in enrollment in either two- or four-year colleges.

By the end of the first year of postsecondary education, 2.6 percent of female and 1.8 percent of male P-TECH 9-14 students had earned degrees, compared with virtually no students from the comparison group, of either gender. These impacts for both genders are statistically significant.

It is worth noting that these differences between male and female students in postsecondary enrollment and degree attainment mirror fairly long-standing national trends. More female students have enrolled in postsecondary education and attained college degrees than male students since the 1980s.[26]

25. Jagesic, Ewing, Wyatt, and Feng (2022).

26. Conger (2015); Conger and Long (2010); Fortin, Oreopoulos, and Phipps (2015); Statista Research Service (2021).

Two Years of Postsecondary Education: Enrollment and Degrees

Impacts for the Full Sample

As shown in Figure 4.4, at the end of two years after expected high school graduation, 60 percent of students in both the P-TECH 9-14 and comparison groups were enrolled in either a two- or four-year degree program or had earned a degree. At this point, there were not statistically significant differences between groups in degrees earned.

Impacts by Gender

Similar patterns as were observed in the first postsecondary year were also seen in the second postsecondary year. Among female students, 40 percent of the P-TECH 9-14 group were enrolled in two-year colleges compared with 31 percent of the comparison group, a difference that is statistically significant (as shown in Appendix Table A.5). Overall, however, among female students, there was not a statistically significant difference in college enrollment between the P-TECH 9-14 and comparison groups. Among male students, there were also not statistically significant differences in college enrollment between the P-TECH 9-14 and comparison groups, although lower percentages of male students than female students were enrolled in both groups.

By the end of two postsecondary years, around 7 percent of female students in both the P-TECH 9-14 and comparison groups had competed degrees. However, among male students, almost 5 percent of P-TECH 9-14 group students had earned degrees, compared with 2 percent of comparison group students, a difference that is statistically significant. These findings suggest that while female students in the comparison group performed as well as female students in the P-TECH 9-14 group, male students who had the chance to attend P-TECH 9-14 schools were more likely to attain college degrees than male students assigned to other kinds of schools.

Three Years of Postsecondary Education: Enrollment and Degrees

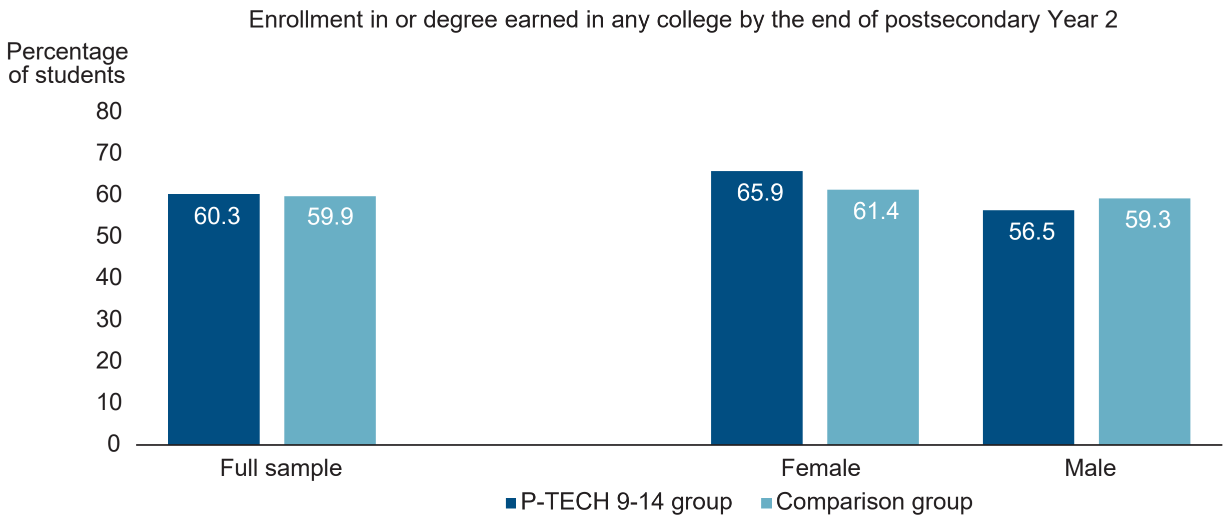
Impacts for the Full Sample

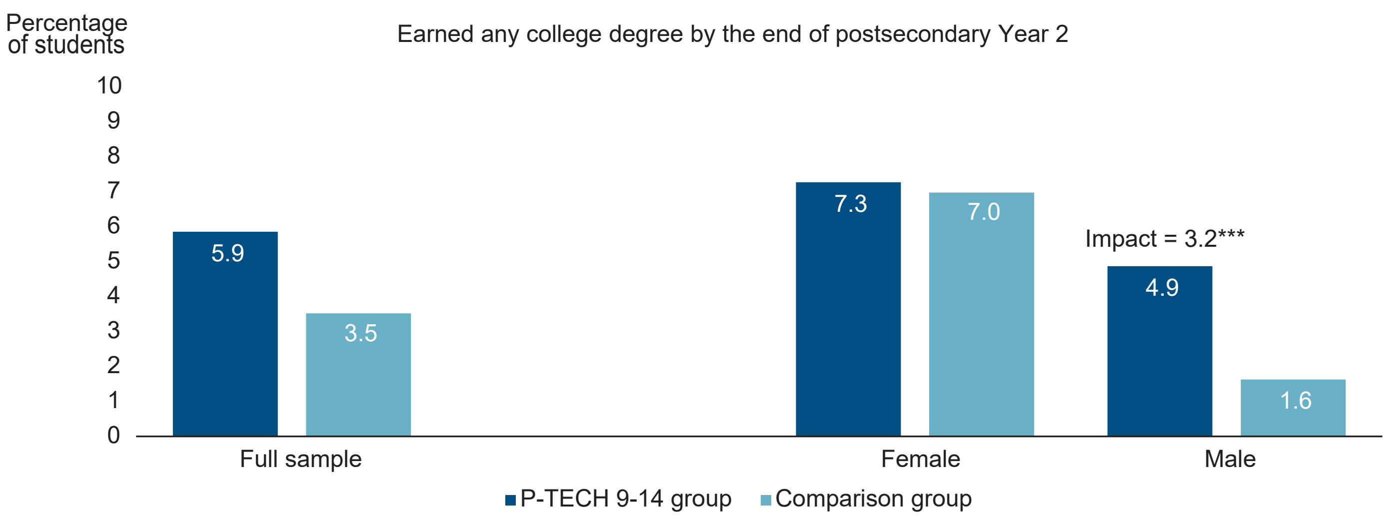
At the end of three years after expected high school graduation, as shown in Figure 4.5, there were not statistically significant differences between the P-TECH 9-14 and comparison groups in college enrollment. As shown in Appendix Table A.6, there were not statistically significant differences in enrollment at colleges of any kind, at either two- or four-year colleges. However, at this point, 13 percent of students in the P-TECH 9-14 group had earned a college degree compared with 8 percent of students in the comparison group, and this difference is statistically significant. That said, most (78 percent) of the students who had earned a two-year degree at this point were also enrolled in four-year programs.

Impacts by Gender

Among male students, there were large, positive, and significant differences between the P-TECH 9-14 and comparison groups in four-year college enrollment and degree attainment.

Figure 4.4
Any College Enrollment and Degree Attainment in Postsecondary Year 2

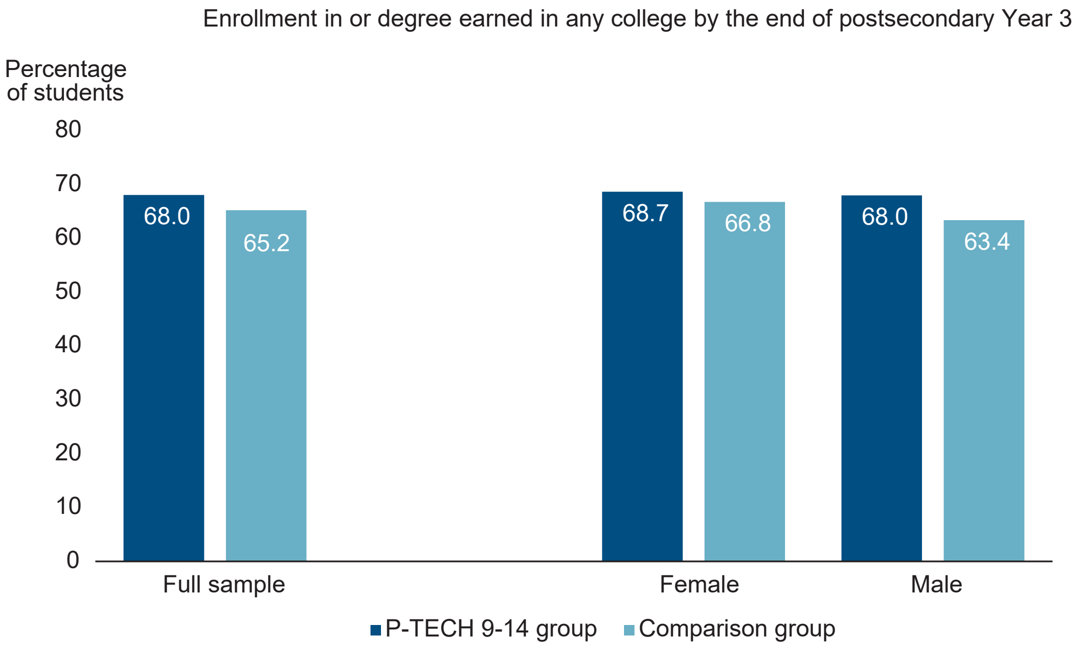


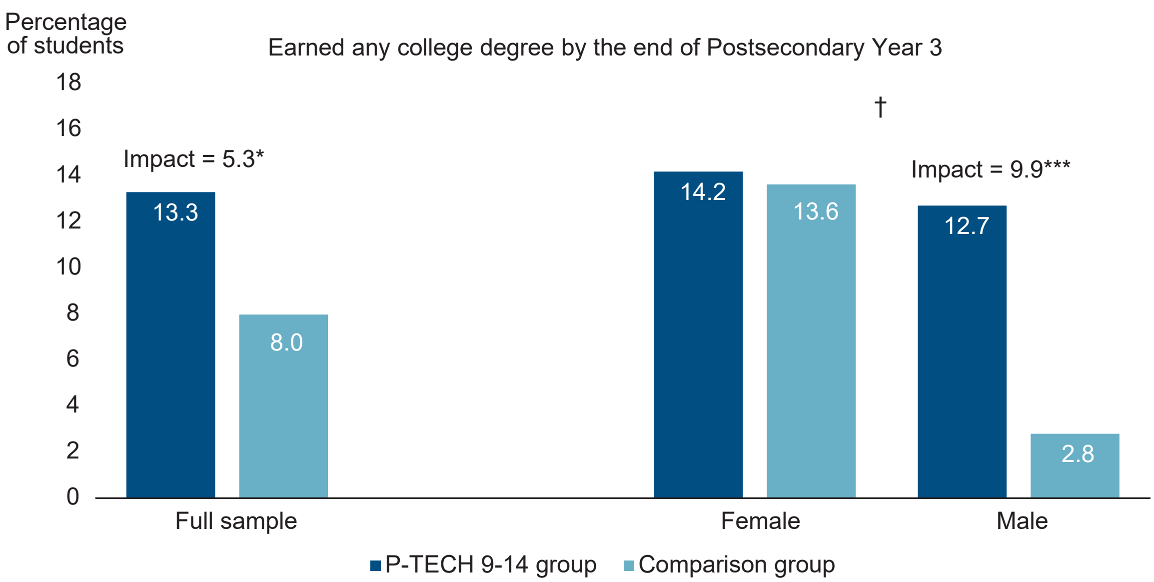


SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between P-TECH 9-14 group and comparison group members and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Figure 4.5
Any College Enrollment and Degree Attainment in Postsecondary Year 3





SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between P-TECH 9-14 group and comparison group members and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Specifically, 39 percent of male students in the P-TECH 9-14 group were enrolled in four-year colleges compared with 26 percent of the comparison group, and almost 13 percent of male P-TECH 9-14 group students had earned degrees compared with 3 percent of male comparison group students. In contrast, 14 percent of female students in the P-TECH 9-14 group and 13 percent of female students in the comparison group had earned degrees at this point.[27]

These findings suggest that while female students earned postsecondary degrees at similar rates, no matter what kind of high school they were assigned to, the P-TECH 9-14 model had a larger impact on degree attainment among young men.

DISCUSSION

This study of the New York City P-TECH 9-14 schools found that by the end of three years of postsecondary education, 13 percent of students in the P-TECH 9-14 group had completed postsecondary degrees, compared with 8 percent of the students in the comparison group. This overall impact primarily reflects impacts among young men.

It would be helpful to situate these results among findings from other studies, to put the size of this impact into context. However, the postsecondary educational findings from this study cannot be readily compared with studies of other postsecondary interventions. Most studies of postsecondary education begin with a sample of students who have chosen to enroll in college and, by definition, do not include those students who never enroll in college. In contrast, this study begins with students in the ninth grade, many of whom will not enroll in college at all in the years that can be measured, after the end of four years of high school.

For these reasons, the best comparisons for the P-TECH 9-14 schools are other models in which students in the sample move between high school and postsecondary education. In the evaluation of the Early College High Schools (ECHS) in North Carolina, researchers found that ECHS students were approximately 15 percentage points more likely to have earned an associate's degree than students in a comparison group, four years after the end of high school.[28] This result is comparable to these findings for male students in this study, measured at three years, and higher than the 5 percentage point impact found here for the full sample at the three-year mark.

27. There appears to be a large difference in four-year college enrollment and degree attainment between cohorts of young men followed to Years 2 and 3 of postsecondary education. The research team has determined that this discrepancy is due to a cohort effect in which the 2015 cohort had unusually low outcomes, compared with other cohorts. Results of a cohort-effects analysis are presented in Appendix A.

28. Edmunds et al. (2020).

Additionally, it is interesting to note that a similar study comparing New York City students enrolled in CTE and non-CTE schools (which overlapped in its evaluation period with this study) did not find significant differences in college enrollment between students in these two different kinds of schools. (Degree attainment was not measured.)[29] However, when the same study focused on small CTE schools where the programs were specifically designed to help students enter college, the impact on four-year college enrollment was 10 percentage points. In that study, however, most of the students reached their first postsecondary year before 2020, when the COVID-19 pandemic began. Combined, these studies suggest that P-TECH 9-14 schools may have done better at facilitating college enrollment and postsecondary degree attainment than similarly career-themed New York City high schools, particularly for young men. At the same time, it is important to note that most of the students in the P-TECH 9-14 sample were enrolled in postsecondary education during the years in which education was most heavily affected by the COVID-19 pandemic. This was a time when postsecondary enrollment declined nationally, with direct high-school-to-college enrollments and community college enrollments experiencing some of the largest declines. Notably, this was also a time when male enrollments declined more sharply than female enrollments.[30] Given this context, it is possible that the results of this study may have been muted by the effects of the pandemic on students' experiences. Further research that follows later cohorts of students into postsecondary education in years after 2021 might help shed light P-TECH 9-14 schools' true potential to promote postsecondary enrollment and degree completion.

It is additionally important to put the findings related to young men into the context of other research about this population. Nationally, male students have lagged female students in multiple markers of academic success for decades (as cited above), particularly in college enrollment and postsecondary degree attainment. At the same time, these findings add to a body of literature that have found CTE engagement can have positive impacts for young men, including an MDRC evaluation of Career Academies, some recent studies of regional vocational technical high schools in Connecticut, and an early evaluation of a high school internship program.[31] Moreover, as in this study, most of those other studies did not find impacts for female students, because female students engaged in postsecondary education at similar rates, whether they received CTE or not. Impacts were found for male students because the CTE program experience helped them succeed in ways other programs did not.

At the same time, female students in the P-TECH 9-14 group were more likely than female students in the comparison group to enroll in two-year programs rather than four-year programs. This finding indicates that the P-TECH 9-14 model may have induced female students to choose two-year over four-year programs, possibly leading them to less selective programs

29. Kemple, Unterman, and Dougherty (2023).

30. Conley and Massa (2022).

31. Kemple and Wilner (2008); Brunner, Dougherty and Ross (2023); Theodos et al. (2016), although the positive results mentioned were not found in the longer-term follow-up study of the same program.

than they might have qualified for, and ones that offered lower levels of attainment than they might have otherwise chosen (a phenomenon known as *undermatching*). There is some emerging evidence that programs in which students take many dual-enrollment credits can lead students to make these types of choices.[32] Further research is needed to determine whether female P-TECH 9-14 students later transferred to or received four-year degrees, and whether undermatching for female students persists over a longer time window, or for other cohorts of students.

32. Jagesic, Ewing, Wyatt, and Feng (2022).

5

Cost and Cost-Effectiveness of P-TECH 9-14

This chapter presents the secondary and postsecondary costs of P-TECH 9-14 schools, and the cost-effectiveness of the model in helping students earn postsecondary degrees by the end of Year 6 (the sixth year after students enter high school). The P-TECH 9-14 model requires significant investments beyond the funding that high schools typically receive: It relies on partnerships among the school district, community colleges, and industry partners, and supports students for two additional years beyond the typical four years of high school. The information provided in this chapter sheds light on the total cost of these societal investments in P-TECH 9-14 schools, and compares these costs with those of the average high school experience in the comparison group. The chapter presents the model's cost-effectiveness at helping students earn postsecondary degrees, meaning how much it cost to produce a single postsecondary degree among students in the P-TECH 9-14 group and the comparison group.

Findings:

- **Secondary education costs** (those costs incurred when students were enrolled at high school) were an average of 19 percent higher per student for the P-TECH 9-14 group than the comparison group. The additional costs were due to P-TECH 9-14 schools' smaller size, the dedicated support they received from the district, and the investments of their industry partners, and because P-TECH 9-14 schools also received secondary education funding for supporting students who elected to continue on their schools' postsecondary degree pathways after their senior years of high school.

- **Postsecondary education costs** were higher for the P-TECH 9-14 group, as would be expected for a model that sought to have students complete both high school and postsecondary degrees within six years. Additionally, P-TECH 9-14 students were able to take more college credits during high school than other New York City high schools allowed.

- **P-TECH 9-14's cost-effectiveness** in relation to college degrees earned varied considerably between two cohorts who were the focus of the cost study. For the cohort of students who started P-TECH 9-14 in the 2013-2014 school year, P-TECH was cost-effective, meaning the cost per degree earned was less for the P-TECH 9-14 group than the comparison group. In that cohort, the P-TECH 9-14 group earned more college-level credits in high school and earned more postsecondary degrees than the comparison group. The model was not cost-effective for the cohort that started in the 2014-2015 school year. In that cohort, the P-TECH 9-14 group earned college credits and postsecondary degrees at similar rates to the comparison group.

COST AND COST-EFFECTIVENESS ANALYSIS APPROACH

Cost and cost-effectiveness analyses provide another way of assessing the P-TECH 9-14 model's services and results. The cost analysis provides information about how the costs of a six-year program compare with those of the typical four-year high schools that the comparison group enrolled in. The cost-effectiveness analysis expresses the costs of the two approaches (P-TECH 9-14 and typical four-year high schools) as the cost per unit of the intended outcomes. In this report, the outcome considered is completion of a postsecondary degree six years after enrollment into the study. Since P-TECH 9-14's model intends for students to have the opportunity to receive a postsecondary degree — free to them — within two years of the end of high school, the model requires a public investment above and beyond what is typically invested by either New York City Public Schools (NYCPS) or the City University of New York (CUNY). Such an investment may result in larger returns to society through more tax revenue (as people who have college degrees tend to earn more) and through other benefits associated with increasing levels of education.[1] The cost-effectiveness analysis in this report does not answer the larger question of whether the P-TECH 9-14 model is ultimately beneficial to society in monetary terms.[2] Rather, it provides information six years after students entered the study to show whether P-TECH 9-14 is cost-effective in terms of postsecondary degrees, which may be helpful for decision-makers who are weighing alternative approaches to helping people complete postsecondary degrees.

This chapter answers the following research questions:

- What were the total high school education costs per student of the P-TECH 9-14 model?
- What were the total postsecondary education costs per student of the P-TECH 9-14 model?
- How do the costs of the P-TECH 9-14 model compare with the costs of typical education (as represented by the comparison group)?

1. Carnevale, Cheah, and Rose (2011); Zaback, Carlson, and Crellin (2012); Hout (2012).
2. A separate analysis of other early college programs found that those programs were beneficial to society. Atchison et al. (2021).

- What is the cost-effectiveness of the P-TECH 9-14 model with respect to postsecondary degrees earned?

The team analyzed the costs and cost-effectiveness of two separate cohorts of students in the study: students who entered ninth grade in the 2014-2015 school year and those who entered ninth grade in the 2015-2016 school year.[3] For each cohort, costs are calculated for six years, which reflects the intended duration of the P-TECH 9-14 model. Because the analysis is not for the full sample and outcomes beyond six years are not considered, the findings presented in this chapter should be considered limited and preliminary. Costs are inflation-adjusted to December 2022 prices and discounted to the first year of enrollment (2014-2015 or 2015-2016, depending on the cohort) using a discount rate of 3.5 percent.[4] Prices are local to New York City. Although national prices (which would be lower than those in New York City) are not provided, the chapter includes a discussion about how the costs of P-TECH 9-14 schools might be different in other contexts in the United States.[5]

Costs are considered from the perspective of society (meaning they provide total costs to government entities and industry partners of the services provided to sample members, regardless of who paid), though not all costs could be estimated and included. The costs presented are mainly those incurred by New York City and New York State. Costs incurred directly by students and families, such as the costs of transportation or books, were not estimated and are not included. New York City funds P-TECH 9-14 schools through NYCPS and pays the costs of the credits P-TECH 9-14 students and other dual-enrollment students (such as those in College Now) take at CUNY. NYCPS and CUNY also share the costs of credits P-TECH 9-14 students take at CUNY in Years 5 and 6 if they continue on P-TECH 9-14 degree pathways. Although NYCPS does not automatically pay for college credits for students in the comparison group, those students may have enrolled in CUNY programs that do pay for their credits, such as Accelerated Study in Associate Programs (ASAP).[6]

3. The research team prespecified an analysis plan for the cost-effectiveness analysis in January 2019. This plan specified that the cost analysis would focus on the cohort that entered the study in 2015-2016, which includes six of the seven P-TECH 9-14 schools that were established enough to have admissions lotteries at that point. The COVID-19 pandemic massively disrupted education starting in 2019-2020, which included the last 18 months of the follow-up period for this prespecified cost-analysis cohort. Because it is impossible to know what this cohort's costs and outcomes at six years would have been had the pandemic not occurred, the research team decided to also conduct the cost and cost-effectiveness analyses for the cohort that entered the study in 2014-2015 and had only their last six months of the follow-up period disrupted by the pandemic. This cohort represents students at only three P-TECH 9-14 schools.

4. A discount rate of 3.5 percent was applied to convert dollars to their present value. Present values reflect the idea that people value the money they have now more than the money that they will earn or spend in the future. Moore et al. (2004).

5. For example, in 2021, prices in New York State were the fourth highest in the nation, more than 9.5 percent higher than the national average and 22.9 percent higher than those in the lowest state. Bureau of Economic Analysis (2022).

6. For information about the services provided to students through CUNY ASAP, see City University of New York, "Accelerated Study in Associate Programs (ASAP): About." (n.d.).

HIGH SCHOOL EDUCATION COSTS

P-TECH 9-14 high schools in New York City are funded the same as other New York City high schools. The district uses a weighted, per-pupil funding model, where the majority of each school's funding is based on the number of enrolled students and those students' needs. For example, schools receive more funding for students who have special education needs. Relevant to P-TECH 9-14, schools that NYCPS has designated as CTE high schools receive additional funding based on the programs of study they offer.[7] Schools may also receive additional funds for specific purposes, such as supplemental arts programs, out-of-school-time programs, or advanced placement initiatives.

The research team estimated secondary education costs using the same data from NYCPS used elsewhere in this report, as well as per-pupil expenditures from the School-Based Expenditure Report (SBER), a city data source that provides per-pupil expenditures for each New York City public school.[8] Cost estimates were based on the schools where students actually enrolled, not where their lottery match assigned them. The P-TECH 9-14 group mainly enrolled at P-TECH 9-14 schools, while the comparison group enrolled at hundreds of different high schools. For example, the comparison group for the 2014-2015 cohort enrolled in ninth grade at 102 other high schools, with most of these schools having one or two comparison group members. Seventy-nine percent of the P-TECH 9-14 group in that cohort enrolled in one of the three P-TECH 9-14 schools in operation that year.

A share of the sample (10 percent to 18 percent, depending on cohort and group status) enrolled in non-NYCPS schools, which meant their school costs were not available in the SBER data. Many of these students enrolled at charter schools, and the research team estimated their costs based on the amount New York State sets for charter schools to be reimbursed for each student enrolled.[9] The remainder of the students had a status of "discharged" or "dropout," which meant they did not attend either a NYCPS school or a charter school. They could have stopped attending school altogether, attended a private school, moved to another district, or been homeschooled. For this analysis, their costs are assumed to be zero.[10]

7. For more information, see New York City Public Schools (2023a). For example, in 2023-2024, CTE allocations added between $200 and $1,100 of funding per student, depending on the type of CTE program. See New York City Public Schools, "FSF Category: Portfolio High Schools" (n.d.).

8. These reports were published through 2017-2018 when New York City transitioned to School Funding Transparency Reports, which report expenditures differently and are not directly comparable to the SBER reports. The research team used SBER data to identify expenditure trends from 2015-2016, 2016-2017, and 2017-2018 to project expenditures for 2018-2019, 2019-2020, and 2020-2021.

9. Charter school prices were drawn from the following sources: 2014-2015, 2015-2016, and 2016-2017 were from Domanico and Smith (2017); 2017-2018 was from New York City Charter School Center (2017); 2018-2019 was from New York City Charter School Center (2018); 2019-2020 was from New York City Charter School Center (2019); and 2020-2021 was from New York State Education Department (2020).

10. The number of students who are assumed to have $0 costs fluctuated each year as students left NYCPS schools or charter schools, or reenrolled. Looking at ninth grade only, for the 2014-2015 cohort, costs are assumed to be $0 for 9 percent of the P-TECH 9-14 group and 11 percent of the

The research team also estimated costs for the additional support that P-TECH 9-14 schools received from NYCPS's Office of Postsecondary Readiness (OPSR). The team calculated the cost of the salaries and benefits of two staff members at OPSR whose time was dedicated to the P-TECH 9-14 schools, and then divided the result by the total number of students enrolled in P-TECH 9-14 schools to arrive at a cost per student.[11] Other OPSR staff members provide support to other New York City high schools that comparison group students may have enrolled in, but since this other support provided by OPSR is also available to P-TECH 9-14 schools, these costs are assumed to be the same for the P-TECH 9-14 and comparison groups and are therefore not included in the analysis.

P-TECH 9-14 schools also receive direct and in-kind support from their industry partners. In interviews with the research team, industry partners described the ways that they contributed to the P-TECH 9-14 schools. These investments include staff members who were dedicated to supporting the partnership; allotting a portion of other staff members' time for mentoring, organizing, and hosting events for P-TECH 9-14 students; providing professional development opportunities for school staff members; and providing gifts to students (such as company-branded swag and tickets to local sporting events). These companies did not typically track or make available detailed data on the full costs of supporting P-TECH 9-14 schools, so the research team estimated their costs using their descriptions of the resources they allocated to the partnership. On average, industry partners invested about $150,000 of their own resources per school per year, mostly through allocating their own staff members' paid time to work on P-TECH 9-14 activities.[12] This total amount averaged to about $313 per student.

Table 5.1 shows costs of high school after four and six years, by cohort and study group. As shown, the high school costs after four years are higher for the P-TECH 9-14 group for both cohorts: $7,560 more for the 2014-2015 cohort and $4,520 more for the 2015-2016 cohort. This difference is largely the result of a combination of higher per-pupil costs for the schools, industry partner costs, and OPSR support costs. Some of the lower per-pupil costs for the comparison group can be accounted for because the comparison group had a greater share of students who enrolled in charter schools, which had lower costs. Among NYCPS schools, there were no systematic differences in per-pupil expenses between P-TECH 9-14 schools and comparison schools. In some years, P-TECH 9-14 schools had higher per-pupil expenses than comparison schools; in other years the opposite was true. These shifts probably reflect, as least in part, changes in per-pupil allocations each year as the composition

comparison group. For the 2015-2016 cohort, costs are assumed to be $0 for 9 percent of the P-TECH 9-14 group and 10 percent of the comparison group.

11. This estimate probably is a lower bound on the costs of OPSR support to P-TECH schools since it does not include any management, legal, or other staff time spent supporting P-TECH schools in the New York City Public Schools central office. Enrollment is based on total enrollment in P-TECH 9-14 schools in 2018-2019, to reflect a midpoint in the analysis period.

12. These average costs do not include IBM, which as the founding industry partner provided many forms of support to the first P-TECH school in its initial years. Rather, these average costs reflect what might be expected for a typical industry partner to invest once a school is up and running.

Table 5.1

High School Education Costs, by Research Group and Cohort

2014-2015 Cohort	P-TECH 9-14 Group 4 Years	P-TECH 9-14 Group 6 Years	Comparison Group 4 Years	Comparison Group 6 Years	Difference
School	$85,007	$101,878	$78,967	$84,703	$17,175
Industry partner	$1,190	$1,190			$1,190
OPSR support	$335	$485			$485
Total direct costs	$86,531	$103,553	$78,967	$84,703	$18,850
Sample size		305		173	

2014-2015 Cohort	P-TECH 9-14 Group 4 Years	P-TECH 9-14 Group 6 Years	Comparison Group 4 Years	Comparison Group 6 Years	Difference
School	$89,489	$105,176	$86,492	$91,962	$13,215
Industry partner	$1,190	$1,190			$1,190
OPSR support	$335	$485			$485
Total direct costs	$91,014	$106,852	$86,492	$91,962	$14,890
Sample size		213		499	

SOURCES: MDRC analysis of financial and administrative data from NYCPS and industry partners.

NOTE: Dollars are expressed in December 2022 values using data from the Consumer Price Index.

of these schools' student bodies changed (for example, as they saw changes in the share of their students in special education).

The high school cost differences between research groups are more pronounced at six years, when the cost differential increases to about $18,850 for the 2014-2015 cohort and $14,890 for the 2015-2016 cohort. Why does this change occur? Students who graduated or dropped out are not enrolled and therefore are not considered to accrue costs for the years they are not enrolled. As most students graduate high school by Year 4, the secondary education costs drop dramatically in Years 5 and 6. This drop is observed clearly in the comparison group, where only about 10 percent to 12 percent of the sample was still enrolled in a NYCPS school or charter school in Year 5 or 6. However, the P-TECH 9-14 schools still had about a third of their students enrolled in Years 5 and 6, and were receiving the same amount of funding per pupil from NYCPS for those enrollments.

The estimate of high school costs has some limitations. It is possible that some years of high school are more expensive than others due to intended course progression or work-based learning opportunities that are only available in specific years of high school. The weighted student funding formula does not vary based on a student's grade in school, and so each grade level is assumed to have the same cost. Additionally, students in work-based learning in both the P-TECH 9-14 and comparison groups probably participated in paid internships that were offered through New York City's Department of Youth and Community Development Summer Youth Employment Program (SYEP). SYEP is a large program, serving more than 100,000 young people each summer.[13] Data were not available about enrollment in SYEP, and thus these costs are not included.

P-TECH 9-14's model provides students with the opportunity to complete a postsecondary degree by the end of Year 6. While localities are required to provide free education up through a high school diploma, city support for two years of college after high school graduation is much less common. The next section considers the separate costs of postsecondary education, which are in addition to high school costs.

POSTSECONDARY EDUCATION COSTS

The postsecondary cost analysis focuses on the total cost of credits taken at CUNY for the six years after students enrolled in ninth grade. Costs include both college-level credits attempted during high school and college credits attempted after a student completed high school. This analysis focuses only on the costs of credits at CUNY schools, because data on other colleges were not available. This lack of data limits the analysis because even though most students enrolled in a CUNY school, not all did. Among the share of the sample that enrolled in college in Year 5, 22 percent of P-TECH 9-14 group members and 33 percent of the comparison group enrolled in non-CUNY colleges.

13. New York City Department of Youth and Community Development (2023).

The CUNY postsecondary cost estimates are from the societal perspective, meaning they provide the total cost to society of the credits attempted by sample members, regardless of who paid for the credits.[14] Many sources pay college costs, including local, state, and federal support to colleges; federal financial aid programs; private scholarships; and tuition payments from individuals. Since the research team was not able to estimate costs for each perspective, the societal perspective is used to aggregate the total investment from all potential sources. The cost per credit was calculated using data from the Integrated Postsecondary Education Data System (IPEDS). In this approach, a college's total reported expenses are divided by its total reported credits to arrive at an average cost per credit attempted.[15] Data on credits attempted by sample member, which are available at the college level, are then used to calculate total costs.[16] This approach treats the costs for dual-enrollment courses the same as all other courses at a college, but dual-enrollment classes may have a lower cost when, for example, they are held at a high school or use adjunct instructors. Thus, these estimates should be viewed as an upper bound of the costs of postsecondary credits.

Although the costs of administering dual-enrollment programs are not estimated separately, information on the resources required to run dual-enrollment programs may be useful to readers interested in replicating P-TECH 9-14. In New York City, CUNY and NYCPS incurred costs related to staffing, facilities, and supplies to implement their dual-enrollment programs. CUNY paid instructors to teach classes and had administrative costs associated with operating its dual-enrollment programs. For the P-TECH 9-14 schools, CUNY employed a dedicated liaison at each college partner to support scheduling, advising, and other aspects of the partnership. CUNY also paid the cost of students' books and supplies. An estimate provided by CUNY's Early College Initiative averaged more than $350,000 in costs per P-TECH 9-14

14. Tuition (which dual-enrollment students do not pay in New York City and which was not required for P-TECH 9-14 degree tracks) only covers a portion of the costs of a credit—about 30 percent to 50 percent depending on the locality, according to Belfield, Jenkins, and Fink (2023). Many of the costs were probably borne by New York City or New York State through the general funding provided to CUNY, and funding for specific programs, such as P-TECH 9-14, Early College Initiative, and College Now. Students in the P-TECH 9-14 group may have enrolled in degree programs at CUNY that were not part of the P-TECH 9-14 agreement and paid for credits themselves. Federal or state financial aid programs may also have paid for students' tuition; given the number of students who came from low-income backgrounds, it is likely many were eligible for Pell Grants, the main federal source of income-based college aid.

15. There are limits to this approach. First, it assumes that all credits have equal cost, which is not true. Classes have different sizes or require different resources and facilities (for example, science labs), which will lead to different actual costs. Additionally, this method does not include noncredit courses, meaning that when the total expenses are divided by the total credits to arrive at a cost per credit, noncredit courses, which incur costs to provide, are not included, which leads to an inflated cost per credit. By one estimate, CUNY's enrollments are understated by more than 9,000 full-time-equivalent students' noncredit courses. Romano et al. (2019).

16. Costs per credit varied by college. The average cost per credit across years and colleges (in 2022 dollars) was $904 per credit. Undergraduate tuition in the fall of 2022 was $305 per credit for a part-time student who was an established resident of New York State or City seeking a degree.

school per year during the period that is the focus of the report.[17] NYCPS has an agreement with CUNY to share a portion of these costs.

CUNY also has other dual-enrollment programs that students at non-P-TECH 9-14 schools used. The largest of these is College Now, and it was through that program that comparison group students most often earned college credits while in high school. To support College Now, CUNY employs staff members in its central office to provide overall management, and staff members at each of the colleges who work directly with the partner schools to recruit students, plan courses and programs, and schedule classes. Information about the cost to CUNY per school for College Now was not available. Due to the scale of College Now, CUNY probably invests more per college for College Now than it does for P-TECH 9-14, but those resources are distributed across many more high schools; in contrast, each CUNY P-TECH 9-14 liaison works with only one school.

Table 5.2 shows the credits attempted and postsecondary costs for P-TECH 9-14 and comparison group students. Students who take more credits will have higher costs, since the costs are based on the number of credits attempted. Since the intention of P-TECH 9-14 was for students to earn college credits while in high school and have the opportunity to earn an associate's degree within six years, it is not surprising that the P-TECH 9-14 group's average postsecondary costs were higher than the comparison group's. In the 2014-2015 cohort, the P-TECH 9-14 group's postsecondary education costs were an average of $10,400 more per student than the comparison group's, and in the 2015-2016 cohort, the P-TECH 9-14 group's costs were an average of $3,960 more per student.

The differences in costs are notable between P-TECH 9-14 cohorts. While the comparison group costs were similar for the two cohorts, the average cost per P-TECH 9-14 group member differed by $7,760. The reason is largely that the 2014-2015 P-TECH 9-14 cohort attempted nearly twice as many credits (31 credits compared with 16.7 for the 2015 P-TECH 9-14 cohort). One difference between the cohorts that may be leading to this result was the composition of schools in the 2014-2015 cohort. The earlier cohort included three established P-TECH 9-14 schools, two of which were described in Chapter 2 as actively encouraging students to remain in the school's degree pathway through Year 6. The 2015-2016 cohort reflected six schools, a combination of the three established schools in the 2014-2015 cohort and three newer P-TECH 9-14 schools. These newer schools may have been less successful at enrolling students in college classes while in high school, or less likely to encourage the degree pathway at their CUNY college partners, or both. Another reason for the difference could be the pandemic. The students in cohort 2015-2016 cohort had their sixth year of school fall in the 2020-2021 school year, a time where college enrollments dropped nationally. Still, this cohort also took fewer college credits in high school during their first four years, so the pandemic cannot be the only explanation for the cost differential (an average of 12.4

17. These costs are not included separately to avoid double-counting, since these costs are in the total expenditures that CUNY schools report to IPEDS.

Table 5.2

College Credits Attempted and Costs, by Research Group and Cohort

	P-TECH 9-14 Group		Comparison Group		
2014-2015 Cohort	4 Years	6 Years	4 Years	6 Years	Difference
Credits attempted (#)	12.4	31.0	1.8	16.9	14
Cost of credits attempted ($)	$8,719	$22,953	$1,273	$12,548	$10,406
Sample size		305		173	

	P-TECH 9-14 Group		Comparison Group		
2015-2016 Cohort	4 Years	6 Years	4 Years	6 Years	Difference
Credits attempted (#)	4.6	16.7	1.1	13.8	3
Cost of credits attempted ($)	$4,010	$15,192	$856	$11,229	$3,963
Sample size	213			499	

SOURCES: MDRC analysis of financial and administrative data from IPEDS and CUNY.

NOTE: Dollars are expressed in December 2022 values using data from the Consumer Price Index.

dual-enrollment credits for the 2014-2015 cohort compared with an average of 4.6 for the 2015-2016 cohort).

Bringing secondary and postsecondary costs together, the additional costs of P-TECH 9-14 compared with the comparison group after six years were nearly $29,250 for the 2014-2015 cohort and nearly $18,850 for the 2015-2016 cohort. The majority of these additional costs came from secondary education costs related to the higher per-pupil costs of P-TECH 9-14 schools and the practice of sustaining enrollment in high school during Years 5 and 6. Postsecondary costs accounted for the remainder of the difference.

COST-EFFECTIVENESS

One goal of P-TECH 9-14 was for students to have the opportunity to earn a postsecondary degree within six years (which could be a way to address the national issue of a lack of postsecondary persistence, where many students who start college do not finish, and often incur substantial debt along the way). The cost-effectiveness analysis combines the costs of the two research groups with the percentages of them who attained postsecondary degrees. This estimate provides a cost per degree for the P-TECH 9-14 group and the comparison group, which in turn indicates whether P-TECH 9-14 was a cost-effective approach to helping young people earn postsecondary degrees. This analysis measured degree receipt at six years after each cohort entered ninth grade. The cost per degree for each research group combines the estimated societal postsecondary education costs (described in the last section), plus, for the P-TECH 9-14 group, the incremental costs of high school education (that is, the additional costs of P-TECH 9-14 schools).

The results are displayed in Table 5.3. P-TECH 9-14 was cost-effective for the 2014-2015 cohort, saving more than $125,000 per degree earned. P-TECH 9-14 was not cost-effective for the 2015-2016 cohort (which earned far fewer degrees than the 2014-2015 cohort), adding more than $600,000 per degree. Because the percentages of sample members who completed a degree at six years were low across the board, the cost per degree was very high and also very sensitive to small changes in degree completions. These results and their implications are discussed in the final section below.

NATIONAL CONTEXT

The cost results produced in this report are specific to New York City, which is unusual in many ways, and therefore P-TECH 9-14 costs presented in this study may not be representative of those that might occur in other localities. Some costs may be lower in other places, and other costs and resources may be more readily available in New York City. First, readers should consider the local context of the prices reported here. New York City has the highest spending per pupil in the nation (more than double the national average in fiscal year

Table 5.3

Costs Per Degree for the P-TECH 9-14 Group and Comparison Group at Six Years, by Cohort

2014-2015 Cohort	P-TECH 9-14 Group	Comparison Group	Difference
Incremental P-TECH 9-14 high school costs per group member ($)	$18,850	—	$18,850
Postsecondary cost per group member ($)	$22,953	$12,548	$10,406
Total cost per group member ($)	$41,804	$12,548	$29,256
Earned any degree at six years (%)	7.9	1.9	6.0
Total cost per degree earned at six years ($)	$531,180	$656,938	$(125,758)
Sample size	305	173	

2015-2016 Cohort	P-TECH 9-14 Group	Comparison Group	Difference
Incremental P-TECH 9-14 high school costs per group member ($)	$14,890	—	$14,890
Postsecondary cost per group member ($)	$15,192	$11,229	$3,963
Total cost per group member ($)	$30,082	$11,229	$18,853
Earned any degree at six years (%)	3.3	3.7	-0.4
Total cost per degree earned at six years ($)	$915,352	$304,219	$611,133
Sample size	213	499	

SOURCES: MDRC analysis of financial and administrative data from NYCPS, IPEDS, and CUNY.

NOTE: Dollars are expressed in December 2022 values using data from the Consumer Price Index.

2021 — $29,931 compared with the national average of $14,347).[18] The high school education costs reported here are likely to be much lower in a different locality where per-pupil costs are lower. Postsecondary costs will be lower for similar reasons: CUNY's cost per credit is also much higher than that of other community colleges not in New York City.[19] New York City also has infrastructure to support P-TECH 9-14 schools that might not be easily replicated elsewhere. New York City's vast public transportation system, for which NYCPS provides students with MetroCards, means that students have a free way to commute to colleges and internship opportunities without a car or driver's license.[20]

The cost estimates produced for this report also reflect a particular model for funding early college activities, and other localities have used other models. One study found that early college models can spend less on high school costs than business as usual if students take a large share of their classes at a college. Under those circumstances, instructional costs at the high school will be lower since fewer staff members are needed.[21] Since the high school portions of the P-TECH 9-14 schools were funded using the same per-pupil funding model as other schools, their per-pupil costs were very similar to those of comparison schools.

DISCUSSION

These results reveal that P-TECH 9-14 high schools can generally be operated with resources that are not significantly different than other high schools in the community. P-TECH 9-14 high schools were funded through the same weighted student funding formula as other schools, yielding a similar base cost per student. The largest additional cost for high school came from the practice of continuing per-pupil funding for students still enrolled in P-TECH 9-14 schools through two years of postsecondary education. Beyond per-pupil funding, the additional investments from NYCPS and the industry partners for high school were modest, less than $300 per student per year. The largest additional cost beyond what a school district would normally pay was the dual-enrollment credits. Since P-TECH 9-14 students were not capped at 15 dual-enrollment credits (as the comparison group was), they took many more credits on average, and those credits did come at a higher cost. However, one of the intentions of P-TECH 9-14 was to allow students to receive a postsecondary degree at the end of six years. For the 2014-2015 cohort, this approach does seem to have paid off. A higher percentage of the P-TECH 9-14 group in that cohort earned degrees than the comparison group, resulting in a lower cost per degree. The 2015-2016 cohort complicates this finding; in that cohort the P-TECH 9-14 group earned fewer degrees than the comparison group and for that cohort, the P-TECH 9-14 model was not cost-effective.

18. United States Census Bureau (2021).
19. Romano et al. (2019).
20. New York City Public Schools, "MetroCards" (n.d.).
21. Atchison et al. (2021).

Data availability and follow-up periods mean that only these two cohorts can be included in the cost and cost-effectiveness analyses, which in turn means these findings should be considered preliminary and limited. Given the difference in results between the two cohorts, additional cost analyses on later cohorts are needed to provide more definitive answers on whether or not P-TECH 9-14 is cost-effective at helping students earn postsecondary degrees. This analysis showed that P-TECH 9-14 has the potential to be cost-effective, and by a large amount. However, the analysis shows that the opposite can also be true. Cost analyses (including cost-effectiveness or benefit-cost analyses) over a longer time horizon could be useful; the head start on college credits that P-TECH 9-14 students earn could translate into even larger gains in degree completions or earnings down the road. Or, conversely, degree receipt between the P-TECH 9-14 and comparison groups could even out, changing the cost-effectiveness results in the longer term.

6

Conclusion

This report provides evidence about the impacts of the New York City P-TECH 9-14 school model on student high school and postsecondary educational outcomes for students up to seven years after they entered ninth grade. It describes a promising model in which students had the opportunity during high school to engage in dual enrollment and in internships. Although the pandemic did seem to affect many schools' ability to either provide these activities or engage students in them at the same levels, even during the height of the pandemic, participation in these activities was still much stronger in the P-TECH 9-14 group than in the comparison group. The report also provided evidence of impacts on how many students earned postsecondary degrees within seven years of entering high school, with particularly strong impacts for young men.

This report further identified important sources of variation in implementation of the model across schools that may have had implications for both impacts and costs. In particular, while all of the P-TECH 9-14 schools maintain a dual focus on college and career, their goals for students varied somewhat. Graduating with one of the associate's degrees affiliated with the school's field of focus was not the primary goal for most of the P-TECH 9-14 schools. Rather, most schools viewed the affiliated associate's degree at their partner institution as one of many potential postsecondary options for students. In some schools, not all students were encouraged to take college-level courses while in high school or to pursue that associate's degree. These differences across schools may have affected the cost-effectiveness of the model, as discussed further below.

Given the rapid expansion of this model that has already occurred, the question, "How broadly representative are the findings presented here of what might be found elsewhere?" is pertinent to any policy discussion about similar P-TECH model schools. For this reason, it is worth noting that many of the specifics of the New York City experience with the P-TECH 9-14 schools may not be applicable to similar schools that have opened, or are yet to open, in different contexts. The observed variation in priorities across schools was rooted in school responses to a variety of factors including student interest, family perspectives, participation requirements, and relationships with postsecondary and industry partners. For example, it is likely that some students in any career and technical education (CTE) setting who choose a career theme or pathway in ninth grade may lose interest in that CTE field or become more interested in another field before the end of high school. However, the structure of schools and the admissions system in New York City may make it particularly challenging to address the changing needs and interests of students, because it is hard to change schools after the initial ninth-grade lottery, even if one's assigned school is no longer a good fit. This difficulty in changing schools means that in order to serve students appropriately, schools may feel the need to build in flexibility for students who remain at the school.

At the same time, the variation in the way schools emphasize the pursuit of the affiliated degrees, and the dual-enrollment courses that feed into them, may have implications for the cost-effectiveness of the model. In the 2014-2015 cohort, most students in the P-TECH 9-14 group followed the degree path the model was designed to promote and thus completed postsecondary degrees faster. For that cohort, P-TECH 9-14 provided a cost-effective way for students to earn associate's degrees. However, in the 2015-2016 cohort, a smaller proportion of students were enrolled in schools that adhered to the model as originally designed. For that cohort, P-TECH 9-14 was not cost-effective.

Moreover, compared with other models of dual-enrollment funding, the New York City practice of providing weighted, per-pupil funding for students still enrolled in P-TECH 9-14 schools through two years of postsecondary education may be a funding design that is less cost-effective from the city's perspective than other possible funding models. However, New York City is also unusual in that the majority of its students who pursue postsecondary education do so through the CUNY system. It may make sense to share costs across public education systems that serve the vast majority of city residents if the overall goal of the city's public education funds is to raise the level of educational attainment throughout the city. However, this funding design may make less sense from a cost perspective in cities where it is less clear that students from the city's public high schools will attend its community colleges.

It is also not clear from this study how the model and its implied costs might change in settings with less robust public transportation, and less access to a multitude of employer partners available to support schools.

That said, while there are many ways that New York City provides an atypical setting, this study raises interesting lessons and questions that are probably applicable to similar schools across a variety of settings. For example, it is notable that most of the students in both groups who did not graduate within four years also did not enroll in college-level courses while in high school or have internships. These students may have had these experiences for a combination of reasons: Their schools may not have provided support or access to these opportunities equitably across all students, or the students may have needed more help to be ready to engage with these opportunities. Nonetheless, these findings suggest that this model — designed to accelerate a lot of high school experiences in order to create early access for students to more advanced opportunities — may also need to provide additional assistance to students who are struggling with the standard elements of high school, if they are to achieve these milestones.

It is also notable that the differences between the P-TECH 9-14 group and the comparison group in high school internships and dual enrollment were somewhat larger for students who were able to enroll in four years of high school before the pandemic, probably because it became more difficult for schools to offer opportunities such as internships and hands-on learning in remote and hybrid school environments. However, the fact that the impacts were still large even after the pandemic began suggests that P-TECH 9-14 schools continued to find ways to offer these components of the model and encourage students to engage with them. Learning more about how schools continued to provide these opportunities for students during the pandemic may suggest creative ways to expand the P-TECH model in areas where students have less access to transportation, or where there are fewer local employers.

Finally, this report also showcased findings that suggest that P-TECH 9-14 schools may be particularly effective for young men. These findings are notable particularly compared with the same outcomes for male students in the comparison group. Although female students in the P-TECH 9-14 group earned degrees within two years at the highest rates, female students in the comparison group earned degrees at a similar rate, suggesting that many young women would otherwise perform similarly in many kinds of educational settings. The young men in the comparison group, however, earned degrees at far lower rates than the young men in the P-TECH 9-14 group, suggesting that the structure or opportunities provided by the P-TECH 9-14 model offer levels of support for young men that may not be available to them in other settings. As noted in Chapter 4, these gender differences in outcomes mirror national trends in postsecondary enrollment and attainment that have been well documented for several decades.[1] The fact that P-TECH 9-14 schools seem to provide an avenue to educational success for young men that bucks this trend is promising and suggests, as other literature has, that many CTE programs (for example, Career Academies) help young men achieve success that they otherwise might not find.[2] Understanding the mechanisms that allow young men in P-TECH 9-14 to achieve postsecondary success is an area that is worthy of future research.

RECOMMENDATIONS FOR POLICY AND PRACTICE

Given the proliferation of P-TECH 9-14 model schools, some implications of these findings for the continued expansion of the model and the development of schools include the following recommendations:

- **Clarify the goals of the model.** When the P-TECH 9-14 study schools initially opened, school staff members, partners, and families often assumed that the primary goal would be to get as many students as possible to complete the associate's degree affiliated with the school's field of focus. However, many schools shifted from this primary focus once they were in operation. This change happened as schools learned that many of their students did not want to stay to complete the degree for a variety of reasons, including not being interested in the school's focus, changing their minds about wanting the affiliated

1. Conger (2015); Conger and Long (2010); Fortin, Oreopoulos, and Phipps (2015); Statista Research Service (2021).
2. Kemple and Willner (2008).

degree, or deciding to pursue a different postsecondary degree. Schools implementing the P-TECH 9-14 model in the future may benefit from being clear up front about the goals of the model. Doing so could allow families to make better decisions; help schools plan for the different types of support that they will need to offer to students; and allow schools and districts to make decisions about investing in the P-TECH 9-14 model if the focus is on providing access to career activities and some early college courses, but not necessarily completing a college degree.

- **Set expectations and establish goals for employer partner involvement.** Employer partners play a major role in the P-TECH 9-14 model, but ensuring they can offer substantial work-based learning opportunities has been challenging for most of the study schools. School and employer stakeholders should establish clear goals and expectations for their partnerships such as the number and types of work-based learning activities to which both partners can commit, whether there is a pathway to a good job, and how schools and employers will collaborate to prepare students for work-based learning activities. The partners should also regularly monitor their progress toward these goals and address any problems that have arisen. It is noteworthy that the two schools where employer partners directly hire students who obtain the affiliate associate's degree are the two schools where the principals most actively encourage students to stay and finish those degrees. While most of the study schools have engaged multiple employer partners to cultivate more work-based learning activities, it may be better for schools to have a smaller number of partners who can provide more opportunities and who are committed to long-term partnership. A long-term partnership with a small number of partners may also help protect against problems related to staff turnover at employer partners, as several schools reported it was difficult to maintain partnerships when their primary champion left the employer.

- **Identify challenges and opportunities regarding equitable access to college and career opportunities.** Currently, adults in the P-TECH 9-14 schools influence who has access to work-based learning opportunities based on advising sessions or on which students fulfill participation requirements. For these reasons, schools need to pay particular attention to ensure equitable access to college and career opportunities. Specifically, they need to monitor whether there are students who are either directly or indirectly counseled away from particular college or a career opportunities. Schools often have only a limited number of work-based learning opportunities, and these opportunities are often offered to the highest-achieving students. Being aware of the risk of bias in selection for college and career opportunities may help schools distribute opportunities across their students more equitably.

- **Ensure there is support for students who are struggling.** As described above, the students who did not continue in the postsecondary education portion of the model were mostly the same students who did not enroll in college-level courses while in high school or engage in internships. Schools may be able to provide accelerated or specialized opportunities to more students if they can help students engage in and complete the standard components of high school. Doing so could allow a broader selection of students to take advantage of the defining elements of the P-TECH model.

- **Explore a variety of funding models.** The findings in this report suggest that the P-TECH 9-14 model can be cost-effective under the right circumstances. They also suggest that the New York City model may not be the most efficient way to fund these schools. New schools that are seeking partnerships with colleges and employers may want to explore different ways to fund schools that could make the model feasible across a variety of settings.

NEXT STEPS

This report provides evidence that the New York City P-TECH 9-14 schools were effective at supporting students to earn more postsecondary degrees than students in the comparison group, up to seven years after students entered high school, particularly for young men.

However, given that a majority of students in the analytic sample were still enrolled in postsecondary education at the end of the study period, (including students who had completed a two-year degree and were pursuing four-year degrees), further research would be helpful to follow students to the end of their college experiences. Doing so would provide a more complete picture of the impact and longer-term cost-effectiveness or monetary benefits of the P-TECH 9-14 schools.

In addition, because one of the ultimate goals of P-TECH 9-14 is to provide viable pathways to economic success for students, it would also be useful to conduct further research that links student records to labor market data. About a third of the students who began ninth grade in the study sample did not enroll in postsecondary education at any point during the study period. However, it is unknown at this point whether the model had any impact on the earnings of P-TECH 9-14 and comparison group students who may have entered the labor market immediately following high school. MDRC's study of Career Academies, which also focused on CTE education, did not find impacts on postsecondary attainment, but did find impacts on earnings eight years after the end of high school.[3] This previous rigorous research shows that the benefits of CTE for students' performance in the labor market may not always flow through postsecondary education. Including impacts on labor market outcomes would also make it possible to conduct a more comprehensive cost-benefit analysis of the model.

Likewise, a longer follow-up timeline would also help illuminate whether students who did not enroll in postsecondary education immediately after high school may have done so at later dates. Particularly because the pandemic disrupted so many students' educational experiences, being able to follow students for longer would make it clearer which outcomes may have been temporary responses to the global crisis, and which may be more lasting for students.

Additionally, it also may be important to research further how P-TECH 9-14 affects outcomes for young men, given the national trends mentioned above that show young men to have less

3. Kemple and Willner (2008).

postsecondary success than young women, and particularly given research that indicates that many social policy interventions in some other settings are less successful for men.[4] Other important areas of inquiry include understanding how the model is implemented and how effective it is in different geographic settings with different transportation options for students and access to different employers than are available in New York City.

Overall, however, as the P-TECH 9-14 model has proliferated quickly, it is important to continue to build evidence about the model, to make it clearer how it affects students in the long term and how much the findings presented here may represent what could occur in other settings and circumstances.

4. Reeves (2022).

APPENDIX

A

Technical Appendix

MDRC's first report on the P-TECH 9-14 program provides background information on the technical aspects of the overall evaluation of the New York City P-TECH 9-14 schools that are pertinent for understanding all the analyses presented across reports from this project.[1] These details include an explanation of the New York City high school admissions lottery, sample exclusions, baseline comparisons between the study sample and all students enrolled in P-TECH schools, and the impact model used for analysis. The information can be found in Appendix A of that report.

QUALITATIVE METHODS DETAIL

The qualitative analysis included data from three rounds of interviews with school staff members and additional interviews with employer partners, college partners, and New York City Public Schools (NYCPS) and City University of New York (CUNY) staff members. All interviews were approximately 60 minutes. Nearly all interviews before the spring of 2020 were conducted in person, while interviews after the spring of 2020 and the initial employer partner interviews were conducted virtually on Zoom. Interviews were recorded and transcribed. Details on the types and numbers of interviews are in Appendix Table A.1.

Transcripts were coded using Dedoose, a qualitative data analysis application. First, the team coded the data to extract discussion of high school activities and advising, college activities and advising, work-based learning activities and advising, partnerships, general school information, family involvement, COVID-19 (2022 data only), and implementation successes and implementation challenges. Using these coded data, the team then developed analysis memos on each of these topics that described recurring themes in each and identified the number of schools in which certain topics were discussed. The analysis memos, along with some additional follow-up coding, were then used to create the report.

COMPLETE IMPACTS OUTCOMES

Figures for selected outcomes are presented in Chapter 4. Appendix Tables A.2 through A.6 provide impacts for all the outcomes discussed in that chapter.

1. Rosen et al. (2020).

Appendix Table A.1

Implementation Interview Respondents

Interview and Purpose	Number of Interviews
School-based interviews	
Principal interviews: interviews with the principal or assistant principal to learn about school priorities and services for students	23
Work-based learning coordinator interviews: interviews with work-based learning coordinators, industry liaisons, or both, depending on school staffing structure, to learn about students' work-based learning opportunities and experiences	24
College liaison interviews: interviews with school-based, CUNY-employed college liaisons to learn about students' early college opportunities and experiences	17
Guidance counselor interviews: interviews with guidance counselors focused on college and career preparation to learn about postsecondary advising	17
Student focus groups: focus groups with P-TECH 9-14 students to learn about their experiences and opportunities related to high school, college, and career, as well as the support they receive from adults in the school	13
Partner interviews	
Industry partner interviews: interviews with a representative from the industry partner company to learn about the company's goals for and experience with providing work-based learning opportunities for P-TECH 9-14 students	14
College partner interviews: interviews with a dean from the partner CUNY campus to learn about the college's goals for and experience with providing early college opportunities for P-TECH 9-14 students	7
School district and CUNY partners: interviews with team members who oversee and support the start-up of new P-TECH 9-14 schools in New York City, and who provide ongoing support for P-TECH 9-14 school staff members	4
Total number of interviews	119

NOTE: Interviews with the study schools took place during the 2017-2018, 2018-2019, and 2021-2022 school years. Interviews with employer partners took place during the summers of 2018 and 2021. Interviews with college partners took place in the summer of 2018. Interviews with NYCPS district-level staff members took place in 2022.

Appendix Table A.2

CTE Coursework, Internships, and Dual-Enrollment Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Full sample								
Cumulative CTE/nonacademic credits earned through Year 4[a]	8.0	5.8	2.2 ***		0.45	0.002	1,435	1,571
Any internship by the end of Year 4 (%)	52.8	14.9	37.9 ***		1.12	<.0001	1,479	1,682
Any dual enrollment by the end of Year 4 (%)	46.1	20.1	26.0 ***		0.72	<.0001	1,479	1,682
Cumulative dual-enrollment credits earned through Year 4	6.0	1.5	4.5 ***		0.85	<.0001	1,479	1,682
COVID subgroups								
Cumulative CTE/nonacademic credits earned through Year 4[a]								
Pre-COVID cohorts (2013-2015)	9.0	6.0	3.1 ***		0.61	<.0001	516	641
COVID-affected cohorts (2016 and 2017)	7.4	5.8	1.6 **		0.35	0.038	919	930
Any internship by the end of Year 4 (%)								
Pre-COVID cohorts	67.1	17.4	49.7 ***	†	1.43	<.0001	529	674
COVID-affected cohorts	44.8	14.2	30.6 ***		0.93	<.0001	950	1,008
Any dual enrollment by the end of Year 4 (%)								
Pre-COVID cohorts	49.5	19.8	29.8 ***		0.82	<.0001	529	674
COVID-affected cohorts	44.2	20.6	23.6 ***		0.66	<.0001	950	1,008
Cumulative dual-enrollment credits earned through Year 4								
Pre-COVID cohorts	7.7	1.2	6.5 ***	††	1.53	<.0001	529	674
COVID-affected cohorts	5.1	1.8	3.3 ***		0.56	<.0001	950	1,008

(continued)

Appendix Table A.2 (continued)

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Gender subgroups									
Cumulative CTE/nonacademic credits earned through Year 4[a]									
Female students	9.6	5.4	4.1	***	†††	0.92	<.0001	530	538
Male students	7.1	6.1	1.0	*		0.20	0.053	899	1,004
Any internship by the end of Year 4 (%)									
Female students	60.9	14.3	46.6	***		1.32	<.0001	552	587
Male students	48.2	15.0	33.2	***		1.01	<.0001	921	1,063
Any dual enrollment by the end of Year 4 (%)									
Female students	52.7	25.4	27.3	***		0.66	<.0001	552	587
Male students	42.1	16.7	25.4	***		0.80	<.0001	921	1,063
Cumulative dual-enrollment credits earned through Year 4									
Female students	6.7	1.8	4.9	***		0.80	0.000	552	587
Male students	5.6	1.3	4.3	***		0.90	<.0001	921	1,063

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

[a]The cumulative CTE/nonacademic credits measure excludes physical education and functional code credits.

Appendix Table A.3

Impacts on High School Credits and Graduation

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Full sample								
Cumulative total credits earned, Year 4[a]	41.0	39.9	1.2		0.06	0.198	1,435	1,571
Cumulative academic credits earned, Year 4	28.7	29.7	-1.0	*	-0.07	0.064	1,435	1,571
High school graduation by end of Year 4 (%)	65.8	65.1	0.7		0.01	0.732	1,479	1,682
High school graduation by end of Year 5 (%)	70.6	69.1	1.5		0.03	0.465	1,090	1,074
High school graduation by end of Year 6 (%)	75.6	76.7	-1.1		-0.02	0.672	529	674
COVID subgroups[b]								
Cumulative total credits earned, Year 4[a]								
Pre-COVID cohorts (2013-2015)	42.1	40.1	2.0	*	0.10	0.070	516	641
COVID-affected cohorts (2016 and 2017)	40.4	40.0	0.4		0.02	0.736	919	930
Cumulative academic credits earned, Year 4								
Pre-COVID cohorts	28.7	29.8	-1.1		-0.07	0.205	516	641
COVID-affected cohorts	28.7	29.9	-1.2		-0.08	0.105	919	930
High school graduation by end of Year 4 (%)								
Pre-COVID cohorts	63.7	67.4	-3.7		-0.08	0.290	529	674
COVID-affected cohorts	66.9	63.9	3.1		0.06	0.208	950	1,008
High school graduation by end of Year 5 (%)								
Pre-COVID cohorts	71.3	72.4	-1.1		-0.02	0.713	529	674
COVID-affected cohorts	69.9	66.3	3.5		0.07	0.262	561	400

(continued)

Appendix Table A.3 (continued)

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Gender subgroups								
Cumulative total credits earned, Year 4[a]								
Female students	43.0	40.6	2.4	*	0.12	0.080	530	538
Male students	39.9	39.7	0.2		0.01	0.816	899	1,004
Cumulative academic credits earned, Year 4								
Female students	29.2	30.8	-1.6	**	-0.11	0.049	530	538
Male students	28.5	29.3	-0.9		-0.06	0.230	899	1,004
High school graduation by end of Year 4 (%)								
Female students	69.7	65.5	4.3		0.09	0.150	552	587
Male students	63.5	65.6	-2.1		-0.04	0.411	921	1,063
High school graduation by end of Year 5 (%)								
Female students	72.8	70.1	2.8		0.06	0.372	423	412
Male students	69.1	68.9	0.3		0.01	0.922	661	649
High school graduation by end of Year 6 (%)								
Female students	76.4	76.9	-0.6		-0.01	0.875	220	265
Male students	75.0	77.3	-2.3		-0.05	0.485	308	402

(continued)

Appendix Table A.3 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

[a]Cumulative total credits measures include all credits earned including physical education and functional code credits.

Appendix Table A.4

Postsecondary Year 1 (Program Year 5) Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Full sample									
Enrollment in or degree earned in any college by the end of postsecondary Year 1 (%)	57.1	55.1	2.0			0.04	0.396	1,090	1,074
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 1 (%)	30.2	25.2	5.0	*		0.12	0.077	1,090	1,074
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 1 (%)	28.3	30.1	-1.7			-0.04	0.490	1,090	1,074
Any college degree earned by the end of postsecondary Year 1 (%)	2.2	0.1	2.1	***		0.39	0.005	1,090	1,074
Gender subgroups									
Enrollment in or degree earned in any college by the end of postsecondary Year 1 (%)									
Female students	62.6	58.3	4.4			0.09	0.151	423	412
Male students	53.6	54.0	-0.4			-0.01	0.889	661	649
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 1 (%)									
Female students	31.7	20.7	11.0	***	††	0.27	0.000	423	412
Male students	29.3	28.7	0.7			0.02	0.844	661	649
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 1 (%)									
Female students	33.1	37.4	-4.3			-0.09	0.267	423	412
Male students	25.3	25.7	-0.4			-0.01	0.858	661	649

(continued)

Appendix Table A.4 (continued)

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Any college degree earned by the end of postsecondary Year 1 (%)								
Female students	2.6	-0.1	2.7	*	0.39	0.058	423	412
Male students	1.8	0.3	1.5	***	0.38	0.001	661	649

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Appendix Table A.5

Postsecondary Year 2 (Program Year 6) Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Full sample								
Enrollment in or degree earned in any college by the end of postsecondary Year 2 (%)	60.3	59.9	0.4		0.01	0.895	529	674
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 2 (%)	37.6	32.5	5.1		0.11	0.174	529	674
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 2 (%)	29.1	31.7	-2.6		-0.06	0.424	529	674
Any college degree earned by the end of postsecondary Year 2 (%)	5.9	3.5	2.3		0.13	0.155	529	674
Gender subgroups								
Enrollment in or degree earned in any college by the end of postsecondary Year 2 (%)								
Female students	65.9	61.4	4.5		0.09	0.270	220	265
Male students	56.5	59.3	-2.8		-0.06	0.518	308	402
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 2 (%)								
Female students	39.5	30.5	9.0	**	0.20	0.033	220	265
Male students	36.4	35.0	1.3		0.03	0.771	308	402
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 2 (%)								
Female students	33.6	37.4	-3.8		-0.08	0.469	220	265
Male students	26.0	27.7	-1.7		-0.04	0.602	308	402

(continued)

Appendix Table A.5 (continued)

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Any college degree earned by the end of postsecondary Year 2 (%)								
Female students	7.3	7.0	0.3		0.01	0.914	220	265
Male students	4.9	1.6	3.2	***	0.25	0.006	308	402

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Appendix Table A.6

Postsecondary Year 3 (Program Year 7) Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Full sample								
Enrollment in or degree earned in any college by the end of postsecondary Year 3 (%)	68.0	65.2	2.8		0.06	0.552	316	175
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 3 (%)	41.5	39.7	1.7		0.04	0.722	316	175
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 3 (%)	41.5	34.9	6.6		0.14	0.172	316	175
Any college degree earned by the end of postsecondary Year 3 (%)	13.3	8.0	5.3	*	0.20	0.082	316	175
Gender subgroups								
Enrollment in or degree earned in any college by the end of postsecondary Year 3 (%)								
Female students	68.7	66.8	1.9		0.04	0.785	134	72
Male students	68.0	63.4	4.6		0.09	0.463	181	101
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 3 (%)								
Female students	38.8	33.1	5.7		0.12	0.408	134	72
Male students	43.6	45.8	-2.2		-0.05	0.735	181	101
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 3 (%)								
Female students	44.8	44.3	0.5		0.01	0.939	134	72
Male students	39.2	26.3	13.0	**	0.29	0.044	181	101

(continued)

Appendix Table A.6 (continued)

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Any college degree earned by the end of postsecondary Year 3 (%)								
Female students	14.2	13.6	0.6	†	0.02	0.908	134	72
Male students	12.7	2.8	9.9 ***		0.58	0.000	181	101

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

ROBUSTNESS CHECKS DUE TO MISSING DATA

As in the first report, there were nonrandom patterns of missing data associated with charter school enrollment. Specifically, students initially assigned to schools other than P-TECH 9-14 schools were significantly more likely to enroll in charter schools. Because charter schools do not report all the same data to the district as other schools, being enrolled in a charter school was associated with higher rates of missing data for some outcome measures. In this report, these measures include cumulative total high school credits, cumulative academic credits, and cumulative career and technical education (CTE)/other credits earned by the end of high school.[2] For these measures, the study team conducted bounding exercises in which the highest and lowest possible values for each outcome were imputed for all charter school students with missing outcomes data, to obtain high and low "bounds" around what the impact estimate could be. For course-credit outcomes, at the high end, charter students were assumed to have earned the modal value of credits taken by students in the analysis sample, and at the low end it was assumed charter school students had earned no credits in any years of high school. Although there were some differences in impact significance for cumulative total credits and cumulative academic credits earned for the high and low bounded estimates, as seen in Appendix Table A.7, this exercise did not substantially change the conclusions from the main analysis. As the low imputed estimate reflects active charter school students earning a cumulative total of zero credits in each category through the end of high school, these impacts are particularly unlikely scenarios.

Other outcome measures presented in Chapter 4 also had nonrandom patterns of missing data linked to lottery results, but ones not linked to charter school enrollment. These measures were of high school graduation and internship participation during high school: Comparison group students were more likely to transfer outside the NYCPS system or be coded in the data as inactive students by the end of four years of high school than those in the P-TECH 9-14 group.[3] For these outcomes, the study team imputed missing data to zero, due to the higher probability that these students did not participate in an internship through New York City schools or complete high school due to their transfer or inactive status. However, to explore how this imputation would affect the results, the study team conducted another bounding exercise, in which additional versions of the variables were created where students with missing data were imputed using the highest, rather than lowest, possible value, representing the alternative possibility that these students all experienced the outcome. As with the charter school bounding exercise above, this exercise similarly did not substantively change the conclusions from the main analysis. As seen in Appendix Table A.7, the only impact potentially altered by the high impact estimate was high school graduation by the end of six years of the program, reflecting an unlikely scenario that all transfer and inactive students graduated in that time frame.

2. The cumulative CTE/other credits measure excludes physical education and functional code credits (credits denoting activities such as advisory periods or study hall).

3. Students may be coded as inactive for a variety of reasons, including leaving the district or dropping out without formal withdrawal.

Appendix Table A.7

Bounded Estimates for Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Year 4							
Cumulative total credits earned[a]	41.0	39.9	1.2		0.198	1,435	1,571
High imputed estimate	41.4	40.7	0.7		0.375	1,479	1,682
Low imputed estimate	39.8	37.4	2.4	*	0.056	1,479	1,682
Cumulative academic credits earned	28.7	29.7	-1.0	*	0.064	1,435	1,571
High imputed estimate	28.8	29.9	-1.1	**	0.049	1,479	1,682
Low imputed estimate	27.9	27.9	0.0		0.954	1,479	1,682
Cumulative CTE/other credits earned[a]	8.0	5.8	2.2	***	0.002	1,435	1,571
High imputed estimate	8.0	5.9	2.1	***	0.003	1,479	1,682
Low imputed estimate	7.8	5.4	2.3	***	0.002	1,479	1,682
Any internship by end of Year 4 (%)	52.8	14.9	37.9	***	<.0001	1,479	1,682
High imputed estimate	64.4	28.8	35.7	***	<.0001	1,479	1,682
High school graduation by end of Year 4 (%)	65.8	65.1	0.7		0.732	1,479	1,682
High imputed estimate	78.1	80.1	-2.0		0.340	1,479	1,682
Year 5							
High school graduation by end of Year 5 (%)	70.6	69.1	1.5		0.465	1,090	1,074
High imputed estimate	82.5	85.0	-2.5		0.244	1,090	1,074
Year 6							
High school graduation by end of Year 6 (%)	75.6	76.7	-1.1		0.672	529	674
High imputed estimate	85.1	90.8	-5.7	**	0.010	529	674

(continued)

Appendix Table A.7 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group.

High imputed estimates: For all credits variables, the modal values among records with data were imputed for active charter school attendees. For high school graduation and any internship, the imputed estimates assume the maximum value (indicating the student graduated or had an internship).

Low imputed estimates: For all credits variables, 0 values were imputed for active charter school attendees.

[a]Cumulative total credits measures include all credits attempted or earned including physical education and functional code credits.

Statistically significant differences in missing data rates for students were found for all outcomes affected by nonrandom patterns of missing data.[4] These differences, shown in Appendix Table A.8, range from 2.7 percentage points more comparison group students missing high school graduation status by the end of four years of the program, to 5.4 percentage points more comparison group students missing high school graduation status by the end of six years of the program. However, in all these cases, the level of overall attrition and level of differential attrition indicate a tolerable threat of bias under both optimistic and cautious assumptions.[5]

COMPLIER AVERAGE CAUSAL ESTIMATE (CACE) ESTIMATES FOR IMPACTS

In addition to the main intention-to-treat analysis presented in Chapter 4, CACE analyses were also conducted, in which the estimates were scaled by the number of compliers in the P-TECH 9-14 group — that is, the number of students who actually enrolled in and attended the P-TECH 9-14 schools. This analysis aims to show the impact of the P-TECH 9-14 model for students who attended the schools rather than for all students who were given the opportunity to attend. As presented in the first report, crossover rates from the comparison group to the P-TECH 9-14 group were low (that is, few students who did not win their first lotteries to attend P-TECH 9-14 schools ended up attending them). In Appendix Table A.9, compliance and crossover rates are presented for the fourth year of high school. The CACE estimates, shown in Appendix Table A.10, are similar to the estimated impacts from the main intention-to-treat analysis. A full explanation of the analytic model for CACE estimates is presented in the first report.[6]

4. Dual-enrollment and postsecondary outcomes were not affected by NYCPS enrollment and charter school attendance. Students who were discoverable in these data sources were defined as having experienced the outcome, and those who were not discoverable were defined as having not experienced the outcome.
5. What Works Clearinghouse (2017).
6. Rosen et al. (2020).

Appendix Table A.8

Outcome Measure Missing Rates

Outcome Measure	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference
Year 4						
Missing cumulative total credits earned by Year 4[a] (%)	8.4	12.1	-3.7	*	-0.11	0.082
Missing cumulative academic credits earned by Year 4 (%)	8.4	12.1	-3.7	*	-0.11	0.082
Missing cumulative CTE/other credits earned by Year 4[a] (%)	8.4	12.1	-3.7	*	-0.11	0.082
Missing any internship by the end of Year 4 (%)	12.7	16.2	-3.5	***	-0.09	0.010
Missing high school graduation by the end of Year 4 (%)	12.3	15.0	-2.7	**	-0.08	0.028
Sample size (total = 3,161)	1,479	1,682				
Number of lotteries (total = 42)						
Year 5						
Missing high school graduation by the end of Year 5 (%)	11.9	15.9	-4.0	**	-0.11	0.013
Sample size (total = 2,164)	1,090	1,074				
Number of lotteries (total = 29)						
Year 6						
Missing high school graduation by the end of Year 6 (%)	10.2	15.6	-5.4	***	-0.15	0.009
Sample size (total = 1,203)	529	674				
Number of lotteries (total = 15)						

(continued)

Appendix Table A.8 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group.

[a]Cumulative total credits measures include all credits earned including physical education and functional code credits, while cumulative CTE/other credits measures exclude physical education and functional code credits.

Appendix Table A.9

Active Student Sample Crossover Rates in Year 4

Outcome	P-TECH 9-14 Group	Comparison Group
Compliance rate (%)	84.6	95.9
Crossover rate (%)	15.4	4.1
Sample size (total = 2,686)	1,282	1,404
Number of lotteries (total = 42)		

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Sample sizes reflect the total active student sample for each year, as compliance and crossover rates are calculated based on students active in each year only.

Appendix Table A.10

Complier Average Causal Estimate (CACE) Estimates

Outcome	CACE Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
CTE coursework, internships, and dual-enrollment impacts			
Cumulative CTE/other credits earned through Year 4[a]	2.7	1,435	1,571
Any internship by the end of Year 4 (%)	47.0	1,479	1,682
Any dual enrollment by the end of Year 4 (%)	32.3	1,479	1,682
Cumulative dual-enrollment credits earned through Year 4	5.6	1,479	1,682
High school credits and graduation impacts			
Cumulative total credits earned through Year 4[a]	1.4	1,435	1,571
Cumulative academic credits earned through Year 4	-1.3	1,435	1,571
High school graduation by the end of Year 4 (%)	0.9	1,479	1,682
High school graduation by the end of Year 5 (%)	1.8	1,090	1,074
High school graduation by the end of Year 6 (%)	-0.4	529	674
Postsecondary Year 1 (program Year 5) impacts			
Enrollment in or degree earned at any college by the end of postsecondary Year 1 (%)	2.4	1,090	1,074
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 1 (%)	6.2	1,090	1,074
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 1 (%)	-2.1	1,090	1,074
Any college degree earned by the end of postsecondary Year 1 (%)	2.6	1,090	1,074

(continued)

Appendix Table A.10 (continued)

Outcome	CACE Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Postsecondary Year 2 (program Year 6) impacts			
Enrollment in or degree earned at any college by the end of postsecondary Year 2 (%)	0.5	529	674
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 2 (%)	6.2	529	674
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 2 (%)	-3.2	529	674
Any college degree earned by the end of postsecondary Year 2 (%)	2.8	529	674
Postsecondary Year 3 (program Year 7) impacts			
Enrollment in or degree earned at any college by the end of postsecondary Year 3 (%)	3.4	316	175
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 3 (%)	2.1	316	175
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 3 (%)	8.0	316	175
Any college degree earned by the end of postsecondary Year 3 (%)	6.4	316	175

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group..

[a]Cumulative total credits measures include all credits earned including physical education and functional code credits, while cumulative CTE/other credits measures exclude physical education and functional code credits.

STABLE SAMPLE (2013-2015 COHORTS)

The study team conducted a stable-sample analysis to shed light on the longitudinal impact of the P-TECH 9-14 model on student outcomes for the group of students who could be followed through the entire six-year trajectory of the model. These analyses help disentangle the impacts presented cross-sectionally from the influence of the addition of newer schools to the sample at different points in time. When the sample is restricted to only those cohorts who entered in the falls of 2013 through 2015, then outcomes from high school through two years of postsecondary education can be presented for a consistent group of students. All impacts for the stable sample are shown in Appendix Table A.11.

These results show a pattern similar to that of the full sample overall, with a few exceptions. In comparison with the full sample, among students in the stable sample, there was a statistically significant impact on total high school credit accumulation. In addition, for this sample of students, there was not a statistically significant impact on enrollment in two-year colleges by the end of the first postsecondary year. These findings indicate that while these earlier cohorts may have earned more high school credits than later cohorts, they also may have had a weaker transition to immediate postsecondary enrollment.

COHORT-BY-COHORT RESULTS FOR 2014 AND 2015

Results for the 2014 and 2015 cohorts separately are presented in Appendix Tables A.12 through A.15. These findings are presented to show differences in outcomes by cohort, as discussed in Chapter 5. Due to data availability, comparable outcomes for these cohorts can only be analyzed through the second postsecondary year. In the case of CTE coursework, internships, and dual enrollment (Appendix Table A.12), differences in the magnitude of impacts indicate differing performance by cohort. Notably, the 2014 cohort had a much larger impact than the 2015 cohort on the proportion of students who enrolled in college-level courses while in high school and on the cumulative college credits earned by the end of high school. In both cases, a chi-square test showed these estimated subgroup impacts are different from each other. In the case of postsecondary outcomes for the first year after high school (Appendix Table A.14), the 2014 cohort experienced a positive and significant impact on enrollment or degrees at any college by the end of the first postsecondary year, a finding that was significantly different from the 2015 cohort's estimated impact in a chi-square test. There were also significant differences in impacts by cohort for enrolling in or earning a degree at a four-year college by the end of the first postsecondary year, with a large, negative impact for the 2015 cohort compared with the 2014 cohort, indicating that a smaller percentage of students in the P-TECH 9-14 group attended four-year colleges than comparison group students in this cohort. This significant difference in impacts for enrolling in or earning a degree at a four-year college holds for the second postsecondary year as well (Appendix Table A.15). Additionally, there is a significant difference between the cohorts in impacts in earning any college degree by the end of the second postsecondary year, with the 2014 cohort experiencing a large, positive impact on this measure compared with no significant impact for the 2015 cohort.

Appendix Table A.11

Stable Sample (2013-2015 Cohorts) Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
CTE coursework, internships, and dual-enrollment impacts								
Cumulative CTE/other credits earned through Year 4[a]	9.0	6.0	3.1	***	0.61	<.0001	516	641
Any internship by the end of Year 4 (%)	67.1	17.4	49.7	***	1.43	<.0001	529	674
Any dual enrollment by the end of Year 4 (%)	49.5	19.8	29.8	***	0.82	<.0001	529	674
Cumulative dual-enrollment credits earned through Year 4	7.7	1.2	6.5	***	1.53	<.0001	529	674
High school credits and graduation impacts								
Cumulative total credits earned through Year 4[a]	42.1	40.1	2.0	*	0.10	0.070	516	641
Cumulative academic credits earned through Year 4	28.7	29.8	-1.1		-0.07	0.205	516	641
High school graduation by the end of Year 4 (%)	63.7	67.4	-3.7		-0.08	0.290	529	674
High school graduation by the end of Year 5 (%)	71.3	72.4	-1.1		-0.02	0.713	529	674
High school graduation by the end of Year 6 (%)	75.6	76.7	-1.1		-0.02	0.672	529	674
Postsecondary Year 1 (program Year 5) impacts								
Enrollment in or degree earned at any college by the end of postsecondary Year 1 (%)	57.3	56.2	1.1		0.02	0.719	529	674
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 1 (%)	32.1	27.8	4.3		0.10	0.240	529	674
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 1 (%)	26.5	28.3	-1.8		-0.04	0.589	529	674
Any college degree earned by the end of postsecondary Year 1 (%)	2.5	-0.2	2.6	***	0.48	0.004	529	674

(continued)

Appendix Table A.11 (continued)

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference	Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Postsecondary Year 1 (program Year 6) impacts							
Enrollment in or degree earned at any college by the end of postsecondary Year 2 (%)	60.3	59.9	0.4	0.01	0.895	529	674
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 2 (%)	37.6	32.5	5.1	0.11	0.174	529	674
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 2 (%)	29.1	31.7	-2.6	-0.06	0.424	529	674
Any college degree earned by the end of postsecondary Year 2 (%)	5.9	3.5	2.3	0.13	0.155	529	674

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group.

[a]Cumulative total credits measures include all credits earned including physical education and functional code credits, while cumulative CTE/other credits measures exclude physical education and functional code credits.

Appendix Table A.12

CTE Coursework, Internships, and Dual-Enrollment Impacts, 2014 and 2015 Cohorts

Outcome and Cohort	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Cumulative CTE/other credits earned through Year 4[a]									
2014 cohort	9.3	6.4	2.9	***		0.63	0.001	300	163
2015 cohort	8.8	5.5	3.3	***		0.64	0.000	205	477
Any internship by the end of Year 4 (%)									
2014 cohort	76.4	17.9	58.5	***		1.50	<.0001	305	173
2015 cohort	53.1	9.5	43.5	***		1.32	<.0001	213	499
Any dual enrollment by the end of Year 4 (%)									
2014 cohort	59.7	22.4	37.3	***	††	0.95	<.0001	305	173
2015 cohort	37.6	13.5	24.1	***		0.69	<.0001	213	499
Cumulative dual-enrollment credits earned through Year 4									
2014 cohort	10.6	0.2	10.4	***	†††	1.96	<.0001	305	173
2015 cohort	3.9	0.5	3.4	***		0.91	<.0001	213	499

(continued)

Appendix Table A.12 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

[a]Cumulative total credits measures include all credits earned including physical education and functional code credits, while cumulative CTE/other credits measures exclude physical education and functional code credits.

Appendix Table A.13

High School Credits and Graduation Impacts, 2014 and 2015 Cohorts

Outcome and Cohort	P-TECH 9-14 Group	Comparison Group	Estimated Difference	Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Cumulative total credits earned through Year 4[a]							
2014 cohort	44.5	41.7	2.7	0.15	0.118	300	163
2015 cohort	39.0	37.5	1.6	0.08	0.272	205	477
Cumulative academic credits earned through Year 4							
2014 cohort	30.7	30.8	-0.1	-0.01	0.904	300	163
2015 cohort	26.1	27.9	-1.7	-0.12	0.121	205	477
High school graduation by the end of Year 4 (%)							
2014 cohort	70.2	71.0	-0.8	-0.02	0.855	305	173
2015 cohort	56.8	62.4	-5.5	-0.11	0.248	213	499
High school graduation by the end of Year 5 (%)							
2014 cohort	76.1	78.0	-1.9	-0.04	0.636	305	173
2015 cohort	66.2	66.6	-0.4	-0.01	0.918	213	499
High school graduation by the end of Year 6 (%)							
2014 cohort	80.0	79.0	1.0	0.02	0.803	305	173
2015 cohort	69.0	70.0	-1.0	-0.02	0.778	213	499

(continued)

Appendix Table A.13 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

[a]Cumulative total credits measures include all credits earned including physical education and functional code credits, while cumulative CTE/other credits measures exclude physical education and functional code credits.

Appendix Table A.14

Postsecondary Year 1 (Program Year 5) Impacts, 2014 and 2015 Cohorts

Outcome and Cohort	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Enrollment in or degree earned in any college by the end of postsecondary Year 1 (%)									
2014 cohort	66.9	59.1	7.8	*	††	0.16	0.081	305	173
2015 cohort	45.5	49.6	-4.0			-0.08	0.305	213	499
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 1 (%)									
2014 cohort	32.8	29.7	3.1			0.07	0.527	305	173
2015 cohort	32.4	26.9	5.5			0.13	0.213	213	499
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 1 (%)									
2014 cohort	36.1	29.2	6.8		†††	0.15	0.176	305	173
2015 cohort	13.6	22.3	-8.7	***		-0.19	0.005	213	499
Any college degree earned by the end of postsecondary Year 1 (%)									
2014 cohort	3.3	-0.6	3.9	***		0.51	0.004	305	173
2015 cohort	1.4	-0.2	1.6	**		0.35	0.027	213	499

(continued)

Appendix Table A.14 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Appendix Table A.15

Postsecondary Year 2 (Program Year 6) Impacts, 2014 and 2015 Cohorts

Outcome and Cohort	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Enrollment in or degree earned in any college by the end of postsecondary Year 2 (%)									
2014 cohort	68.9	65.3	3.5			0.07	0.444	305	173
2015 cohort	50.2	52.1	-1.9			-0.04	0.665	213	499
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 2 (%)									
2014 cohort	38.7	36.4	2.3			0.05	0.627	305	173
2015 cohort	37.6	30.2	7.3			0.17	0.104	213	499
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 2 (%)									
2014 cohort	38.7	31.6	7.1		†††	0.15	0.141	305	173
2015 cohort	16.4	26.0	-9.5	***		-0.21	0.002	213	499
Any college degree earned by the end of postsecondary Year 2 (%)									
2014 cohort	7.9	1.9	6.0	***	††	0.32	0.003	305	173
2015 cohort	3.3	3.7	-0.4			-0.02	0.832	213	499

(continued)

Appendix Table A.15 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

GENERAL EDUCATION–ONLY IMPACTS FOR GENDER SUBGROUPS

Impacts by gender are presented for general education students only (that is, excluding students with special education status) in Appendix Tables A.16 through A.20. Restricting the sample to general education students allows the study team to look at the effects of gender without the confounding factor of special education, as most special education students in this analytic sample are male. The impacts for female general education students largely remain the same, but the impacts for male general education students are stronger than they are for the full analytic sample. However, even among the general education population of students, female students performed better than male students on most measures. Notably, there was a significant subgroup difference in the full sample between female and male impacts on enrolling in or earning a degree at a two-year college by the end of the first postsecondary year. However, in the general education–only sample, a chi-square test does not show the estimated subgroup impacts to be different from each other, although the impact for the female subgroup remains significant.

SCHOOL CLIMATE SURVEYS

The survey analysis includes NYCPS survey data from students, parents, and teachers who were surveyed in the spring semesters of 2017, 2018, and 2019. Underlying response rates from these surveys range from 81 percent to 83 percent for the student survey, 52 percent to 53 percent for the parent survey, and 80 percent to 81 percent for the teacher survey during those years.[7]

To conduct relevant analyses, the study team matched the survey data to the study's analytic sample. Matching to the student survey was done by a simple match on student ID code. For the parent survey, as the survey data are linked to the student ID of the parent's oldest child, the match to the sample was conducted using student ID numbers as well. Teacher survey responses could not be linked to individual students. Teacher responses were instead matched to the study sample by school and year. Student survey match rates for the 2017, 2018, and 2019 surveys ranged from 56 percent to 73 percent of the sample, while parent survey match rates ranged from 27 percent to 39 percent of the sample. Note that these match rates also reflect the underlying response rates of the student and parent surveys, as a student or parent nonrespondent falls into the category of nonmatches to the sample. Ninety-nine percent of the schools attended by sample students matched to at least one teacher survey response per year.

7. New York City Public Schools (2022).

Appendix Table A.16

CTE Coursework, Internships, and Dual-Enrollment Impacts for General Education Students Only

Outcome and Gender	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Cumulative CTE/other credits earned through Year 4[a]									
Female students	9.6	5.5	4.1	***	†††	0.89	<.0001	468	488
Male students	7.3	6.3	1.0	*		0.19	0.090	706	702
Any internship by the end of Year 4 (%)									
Female students	60.4	14.0	46.5	***		1.30	<.0001	485	535
Male students	49.8	14.5	35.2	***		1.09	<.0001	725	747
Any dual enrollment by the end of Year 4 (%)									
Female students	55.7	28.1	27.6	***		0.66	<.0001	485	t 535
Male students	47.4	17.8	29.7	***		0.89	<.0001	725	747
Cumulative dual-enrollment credits earned through Year 4									
Female students	7.4	2.1	5.3	***		0.85	0.000	485	535
Male students	6.6	1.4	5.2	***		0.98	<.0001	725	747

(continued)

Appendix Table A.16 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

[a]The cumulative CTE/other credits measure excludes physical education and functional code credits.

Appendix Table A.17

High School Credits and Graduation Impacts for General Education Students Only

Outcome and Gender	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Cumulative total credits earned through Year 4[a]								
Female students	43.1	41.3	1.7		0.09	0.228	468	488
Male students	40.9	40.4	0.5		0.02	0.662	706	702
Cumulative academic credits earned through Year 4								
Female students	29.3	31.4	-2.1	***	-0.14	0.008	468	488
Male students	29.2	29.8	-0.6		-0.04	0.419	706	702
High school graduation by the end of Year 4 (%)								
Female students	70.7	67.2	3.6		0.07	0.226	485	535
Male students	67.2	66.0	1.2		0.02	0.671	725	747
High school graduation by the end of Year 5 (%)								
Female students	73.1	71.6	1.5		0.03	0.628	386	385
Male students	72.5	69.3	3.2		0.07	0.250	530	451
High school graduation by the end of Year 6 (%)								
Female students	76.8	76.5	0.3		0.01	0.935	198	246
Male students	79.2	77.7	1.5		0.03	0.652	255	286

(continued)

Appendix Table A.17 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

[a]The cumulative total credits measure includes all credits earned including physical education and functional code credits.

Appendix Table A.18

Postsecondary Year 1 (Program Year 5) Impacts for General Education Students Only

Outcome and Gender	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Enrollment in or degree earned at any college by the end of postsecondary Year 1 (%)								
Female students	64.0	60.7	3.3		0.07	0.307	386	385
Male students	58.9	55.5	3.3		0.07	0.338	530	451
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 1 (%)								
Female students	30.6	20.1	10.5	***	0.26	0.001	386	385
Male students	30.6	27.7	2.9		0.07	0.415	530	451
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 1 (%)								
Female students	35.8	40.5	-4.8		-0.10	0.255	386	385
Male students	29.6	28.3	1.3		0.03	0.621	530	451
Any college degree earned by the end of postsecondary Year 1 (%)								
Female students	2.8	-0.1	2.9	*	0.40	0.058	386	385
Male students	2.3	0.3	1.9	***	0.41	0.001	530	451

(continued)

Appendix Table A.18 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Appendix Table A.19

Postsecondary Year 2 (Program Year 6) Impacts for General Education Students Only

Outcome and Gender	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value of Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Enrollment in or degree earned at any college by the end of postsecondary Year 2 (%)								
Female students	67.7	63.6	4.1		0.08	0.337	198	246
Male students	62.7	61.2	1.5		0.03	0.772	255	286
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 2 (%)								
Female students	38.4	30.0	8.4	*	0.19	0.055	198	246
Male students	39.2	34.5	4.7		0.11	0.327	255	286
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 2 (%)								
Female students	37.4	40.6	-3.2		-0.07	0.560	198	246
Male students	29.8	29.6	0.2		0.00	0.954	255	286
Any college degree earned by the end of postsecondary Year 2 (%)								
Female students	8.1	6.1	2.0		0.09	0.448	198	246
Male students	5.5	1.4	4.1	***	0.35	0.002	255	286

(continued)

Appendix Table A.19 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Appendix Table A.20

Postsecondary Year 3 (Program Year 7) Impacts for General Education Students Only

Outcome and Gender	P-TECH 9-14 Group	Comparison Group	Estimated Difference			Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Enrollment in or degree earned at any college by the end of postsecondary Year 3 (%)									
Female students	68.7	66.8	1.9			0.04	0.785	134	72
Male students	72.9	64.9	8.0			0.17	0.242	166	64
Enrollment in or degree earned at a 2-year college by the end of postsecondary Year 3 (%)									
Female students	38.8	33.1	5.7			0.12	0.408	134	72
Male students	47.0	45.8	1.2			0.02	0.875	166	64
Enrollment in or degree earned at a 4-year college by the end of postsecondary Year 3 (%)									
Female students	44.8	44.3	0.5			0.01	0.939	134	72
Male students	42.2	26.1	16.1	**		0.34	0.022	166	64
Any college degree earned by the end of postsecondary Year 3 (%)									
Female students	14.2	13.6	0.6		†	0.02	0.908	134	72
Male students	13.3	2.0	11.2	***		0.64	0.000	166	64

(continued)

Appendix Table A.20 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years, American Community Survey data by census tract for median household income from the 2012-2017 calendar years, and CUNY enrollment and degree-attainment data from the 2013-2020 school years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group and: ††† = 1 percent; †† = 5 percent; † = 10 percent for differences in impacts between subgroup pairs.

Potential Sources of Bias and Nonresponse Rates

A number of factors affect the interpretation of these survey data. In some surveys, nonrespondents differ from respondents in significant ways. Student nonrespondents to the survey were more likely to be special education students. Parent nonrespondents were more likely to be parents of students with lower eighth-grade math and English language arts (ELA) test scores. Differences in nonresponse rates among these groups could therefore bias the results, meaning some values may be higher or lower than they would have been had responses from missing respondents been included in the data. In addition, there was often significant variation in mean responses by school and year.

Survey Impact Results

Impacts for the average sample student's expected fourth year of high school are presented in Appendix Tables A.21 through A.23.

Appendix Table A.21

NYCPS Climate Survey: Year 4 Student Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference	Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
General school quality, programs, cleanliness, inclusion, and representation	0.07	0.08	-0.01	-0.01	0.920	274	352
Academic feedback in classes	-0.05	0.06	-0.11	-0.11	0.251	270	357
Personalized attention from teachers	0.03	0.05	-0.02	-0.02	0.862	270	357
Support and respect from teachers and other authority figures	0.08	0.07	0.01	0.01	0.918	269	355
Challenging academic work	-0.08	-0.08	0.00	0.00	0.989	267	353
Overall student behavior and attention in class	0.00	0.01	0.00	0.00	0.970	267	354
School safety	-0.03	-0.02	-0.02	-0.02	0.880	265	351
Bullying, harassment, violence, drugs[a]	0.14	0.08	0.06	0.05	0.531	265	353
Postsecondary and career support and planning	0.24	0.24	-0.01	-0.01	0.960	261	349
College support and planning	0.19	0.30	-0.10	-0.11	0.394	257	335

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years; NYCPS school climate survey data from students, parents, and teachers; and American Community Survey data by census tract for median household income from the 2012-2017 calendar years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group.

[a]This item has been reverse coded so that higher values represent a lower prevalence of negative climate qualities.

Appendix Table A.22

NYCPS Climate Survey: Year 4 Parent Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
School supportiveness toward parents	0.24	0.08	0.16		0.15	0.200	147	167
Overall school quality/community	0.29	0.02	0.27	**	0.29	0.044	143	163
Principal/school leader leadership	0.28	-0.01	0.29	***	0.30	0.009	140	155
Parental involvement in child's education	0.05	0.05	0.00		0.00	0.998	143	167
Satisfaction with school quality and performance	0.34	-0.04	0.38	**	0.37	0.016	141	163
Parental engagement	-0.02	-0.08	0.06		0.05	0.655	143	163
College and career support	0.25	0.02	0.23		0.23	0.136	141	163
Satisfaction with Individualized Education Plan	-0.12	0.16	-0.29	**	-0.28	0.030	92	75

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years; NYCPS school climate survey data from students, parents, and teachers; and American Community Survey data by census tract for median household income from the 2012-2017 calendar years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group.

Appendix Table A.23

NYCPS Climate Survey: Year 4 Teacher Impacts

Outcome	P-TECH 9-14 Group	Comparison Group	Estimated Difference		Effect Size of Estimated Difference	P-Value for Estimated Difference	P-TECH 9-14 Group Sample Size	Comparison Group Sample Size
Overall teacher quality at school	0.23	0.06	0.18		0.17	0.212	515	650
Support in culturally competent and inclusive instruction	0.14	0.18	-0.04		-0.04	0.813	515	650
Respect and trust in school environment	0.36	-0.01	0.38	***	0.35	0.006	515	650
Quality of principal/school leader	0.40	-0.11	0.51	***	0.44	0.000	515	650
Overall school quality and environment	0.25	0.00	0.25	**	0.23	0.043	515	650
Teamwork, shared vision, coordination between teachers and other staff	0.22	0.10	0.12		0.11	0.470	515	650
Teacher-parent communication and coordination	0.10	0.01	0.08		0.07	0.489	515	650
Teacher professional development	0.25	0.07	0.18		0.17	0.261	515	650
Principal/school leaders’ leadership	0.37	-0.03	0.40	***	0.35	0.003	515	650
Constructive criticism and growth culture	0.20	0.04	0.16		0.14	0.252	515	650
Student participation	0.07	0.03	0.04		0.04	0.756	515	650
Student engagement and behavior	0.18	0.01	0.17		0.15	0.141	515	650
Support from adults to students	0.19	-0.02	0.21	*	0.18	0.085	515	650
Postsecondary counseling	0.25	0.04	0.20		0.20	0.311	511	639

(continued)

Appendix Table A.23 (continued)

SOURCES: MDRC's calculations use High School Application Processing System and NYCPS state test data for eighth-graders from the 2012-2017 school years, as well as data from NYCPS enrollment files from the 2012-2020 school years; NYCPS school climate survey data from students, parents, and teachers; and American Community Survey data by census tract for median household income from the 2012-2017 calendar years.

NOTES: Values for the P-TECH 9-14 group are the simple means for all lottery winners. Values for the difference between the P-TECH 9-14 group and comparison group are obtained from a regression of a given outcome on a series of indicator variables that identify each lottery plus an indicator variable that equals 1 for lottery winners and 0 for lottery losers. The coefficient on the latter indicator variable equals the difference in the mean outcome for P-TECH 9-14 group and comparison group members. The value for comparison group members equals the corresponding value for the P-TECH 9-14 group minus the estimated difference between the P-TECH 9-14 and comparison group. The model includes adjustments for selected baseline covariates (female, z-scored eighth-grade ELA test score, missing rate of z-scored eighth-grade ELA test score, z-scored eighth-grade math test score, missing rate of z-scored eighth-grade math test score).

A two-tailed t-test was applied to estimated differences. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent for differences between the P-TECH 9-14 group and comparison group.

REFERENCES

Atchison, Drew, Kristina L. Zeiser, Salma Mohammed, David S. Knight, and Jesse Levin. 2021. "The Costs and Benefits of Early College High Schools." *Education Finance and Policy* 16, 4: 659–689.

Belfield, Clive, Davis Jenkins, and John Fink. 2023. "How Can Community Colleges Afford to Offer Dual Enrollment College Courses to High School Students at a Discount?" CCRC Working Paper No. 130. New York: Community College Research Center, Teachers College, Columbia University.

Bloom, Howard S., Saskia Levy Thompson, and Rebecca Unterman. 2010. *Transforming the High School Experience: How New York City's New Small Schools Are Boosting Student Achievement and Graduation Rates.* New York: MDRC.

Bloom, Howard S., and Rebecca Unterman. 2014. "Can Small High Schools of Choice Improve Educational Prospects for Disadvantaged Students?"*Journal of Policy Analysis and Management* 33, 2: 290–319.

Bloom, Howard S., Rebecca Unterman, Pei Zhu, and Sean F. Reardon. 2020. "Lessons from New York City's Small Schools of Choice About High School Features That Promote Graduation for Disadvantaged Students." *Journal of Policy Analysis and Management* 39, 3: 740–771.

Britton, Tolani, Birunda Chelliah, Millie Symns, and Vandeen Campbell. 2019. *College Now... or Later: Measuring the Effects of Dual Enrollment on Postsecondary Access and Success.* Providence, RI: Annenberg Institute at Brown University.

Brunner, Eric J., Shaun M. Dougherty, and Stephen L. Ross. 2023. "The Effects of Career and Technical Education: Evidence from the Connecticut Technical High School System." *Review of Economics and Statistics* 105, 4: 867–882.

Bureau of Economic Analysis. 2022. "Real Personal Consumption Expenditures by State and Real Personal Income by State and Metropolitan Area, 2021." Website: https://www.bea.gov/news/2022/real-personal-consumption-expenditures-state-and-real-personal-income-state-and.

Carnevale, Anthony P., Ban Cheah, and Stephen J. Rose. 2011. *The College Payoff: Education, Occupations, Lifetime Earnings.* Washington, DC: Georgetown University Center on Education and the Workforce.

City University of New York. n.d. "Accelerated Study in Associate Programs (ASAP): About." Website: https://www1.cuny.edu/sites/asap/about/. Accessed on August 21, 2023.

City University of New York. n.d. "Early College Initiative (ECI)." Website: https://www.cuny.edu/about/administration/offices/evaluation/areas-of-focus_1/college_readiness/early-college-initiative-eci/. Accessed on September 28, 2023.

City University of New York. 2023a. "CUNY to End the Emergency COVID-19 Vaccine Mandate." Website: https://www1.cuny.edu/mu/forum/2023/04/11/cuny-to-end-the-emergency-covid-19-vaccine-mandate/.

City University of New York. 2023b. "Testing FAQs." Website: https://www.cuny.edu/academics/testing/testing-faqs/.

REFERENCES *(CONTINUED)*

City University of New York Early College. n.d. “Our Schools.” Website: https://k16.cuny.edu/earlycollege/our-schools/. Accessed on September 28, 2023.

Conger, Dylan. 2015. “High School Grades, Admissions Policies, and the Gender Gap in College Enrollment.” *Economics of Education Review* 46: 144–147.

Conger, Dylan, and Mark C. Long. 2010. “Why Are Men Falling Behind? Gender Gaps in College Performance and Persistence.” *Annals of the American Academy of Political and Social Science* 627, 1: 184–214.

Conley, Bill, and Robert Massa. 2022. “The Great Interruption.” *Inside Higher Ed*. https://www.insidehighered.com/admissions/views/2022/02/28/enrollment-changes-colleges-are-feeling-are-much-more-covid-19.

Decker, Geoff, and Philissa Cramer. 2013. “What’s Behind the P-TECH Hype? We Answer as Obama Stops By.” *Chalkbeat New York*, October 25. https://ny.chalkbeat.org/2013/10/25/21091564/what-s-behind-the-p-tech-hype-we-answer-as-obama-stops-by.

Dixon, Michelle, and Rachel Rosen. 2022. “On Ramp to College: Dual Enrollment Impacts from the Evaluation of New York City’s P-TECH 9-14 Schools.” New York: MDRC.

Domanico, Raymond, and Yolanda Smith. 2017. “With State Formula for Charter School Funding Likely to Change, City Costs to Grow More Than Budgeted.” New York: New York City Independent Budget Office.

Edmunds, Julie A., Fatih Unlu, Jane Furey, Elizabeth Glennie, and Nina Arshavsky. 2020. “What Happens When You Combine High School and College? The Impact of the Early College Model on Postsecondary Performance and Completion.” *Educational Evaluation and Policy Analysis* 42, 2: 257–278.

Edmunds, Julie A., Fatih Unlu, Elizabeth J. Flennie, and Nina Arshavsky. 2022. *Early Colleges as a Model for Schooling: Creating New Pathways for Access to Higher Education.* Cambridge, MA: Harvard Education Press.

Fink, John. 2023. “What Happened to Community College Enrollment During the First Years of the Pandemic? It Depends on the Student’s Age.” *Mixed Methods Blog*, January 9. https://ccrc.tc.columbia.edu/easyblog/what-happened-to-community-college-enrollment-depends-students-age.html.

Fortin, Nicole M., Philip Oreopoulos, and Shelley Phipps. 2015. “Leaving Boys Behind: Gender Disparities in High Academic Achievement.” *Journal of Human Resources* 50, 3: 549–579.

Hout, Michael. 2012. “Social and Economic Returns to College Education in the United States.” *Annual Review of Sociology* 38: 379–400.

Jagesic, Sanja, Maureen Ewing, Jeffrey N. Wyatt, and Jing Feng. 2022. “Unintended Consequences: Understanding the Relationship Between Dual Enrollment Participation, College Undermatch, and Bachelor’s Degree Attainment.” *Research in Higher Education* 63, 1: 119–139.

Kemple, James J., Rebecca Unterman, and Shaun M. Dougherty, with John Sludden and Samuel J. Kamin. 2023. “NYC as a Laboratory for Learning About Career and Technical Education: Lessons from CTE-Dedicated High Schools.” New York: Research Alliance for New York City Schools.

REFERENCES *(CONTINUED)*

Kemple, James J., and Cynthia J. Willner. 2008. *Career Academies: Long-Term Impacts on Work, Education, and Transitions to Adulthood*. New York: MDRC.

Meyer, Katharine. 2023. "The Case for College: Promising Solutions to Reverse College Enrollment Declines." *Brown Center Chalkboard*, June 5. https://www.brookings.edu/articles/the-case-for-college-promising-solutions-to-reverse-college-enrollment-declines/.

Moore, Mark A., Anthony E. Boardman, Aidan R. Vining, David L. Weimer, and David H. Greenberg. 2004. "'Just Give Me a Number!': Practical Values for the Social Discount Rate." *Journal of Policy Analysis and Management* 23, 4: 789–812.

New York City Career and Technical Education. 2023. "Program Components." Website: https://cte.nyc/web/about-cte/program-components.

New York City Charter School Center. 2017. "Legislative Changes in the 2017-18 New York State Budget Affecting Charter Schools." Website: https://schools.nyccharterschools.org/sites/default/files/resources/Sector-Memo-2017-State-Budget.pdf.

New York City Charter School Center. 2018. "Legislative Changes in the 2018-19 New York State Budget Affecting Charter Schools." Website: https://nyccharterschools.org/wp-content/uploads/2020/10/Charter-Center-Memo-on-2018-State-Budget.pdf.

New York City Charter School Center. 2019. "Legislative Changes in the 2019-20 New York State Budget Affecting Charter Schools." Website: https://nyccharterschools.org/wp-content/uploads/2020/08/Charter-Center-Memo-on-2019-State-Budget.pdf.

New York City Department of Youth and Community Development. 2023. "2023 Summer Youth Employment Program (SYEP) Applications: Open to NYC Young People Aged 14-24." Website: https://www.nyc.gov/assets/dycd/downloads/pdf/2023_SYEP_Applications%20Press_Release2.13.23.pdf.

New York City Department of Youth and Community Development. n.d. "What Is SYEP?" Website: https://www.nyc.gov/site/dycd/services/jobs-internships/about-syep.page#syep-comp.

New York City Department of Youth and Community Development and Workforce Connect. 2021. "SYEP Career Ready Provider List." Website: https://www.nyc.gov/assets/dycd/downloads/pdf/2021CareerReady_Provider_List_Final.pdf.

New York City Public Schools. n.d. "FSF Category: Portfolio High Schools." Website: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.nycenet.edu%2Fofffices%2Ffinance_schools%2Fbudget%2FDSBPO%2Fallocationmemo%2Ffy23_24%2FFY24_docs%2FFY2024_FSF_Portfolio.docx. Accessed on September 27, 2023.

New York City Public Schools. n.d. "MetroCards." Website: https://www.schools.nyc.gov/school-life/transportation/metro-cards. Accessed on August 18, 2023.

New York City Public Schools. 2022. "NYC School Survey Citywide Results." New York: New York City Public Schools. Available at: https://infohub.nyced.org/docs/default-source/default-document-library/public_2022-citywide-analysis-of-survey-results—accessible.pdf.

New York City Public Schools. 2023a. "Funding Our Schools." Website: https://www.schools.nyc.gov/about-us/funding/funding-our-schools.

REFERENCES *(CONTINUED)*

New York City Public Schools. 2023b. "Graduation Requirements." Website: https://www.schools.nyc.gov/learning/in-our-classrooms/graduation-requirements.

New York State. n.d. "School Funding Transparency." Website: https://openbudget.ny.gov/schoolFundingTransparency.html. Accessed on August 18, 2023.

New York State. 2023. "Governor Hochul Announces $31.5 Million Awarded for New York State Pathways in Technology Early College High School Program." Website: https://www.governor.ny.gov/news/governor-hochul-announces-315-million-awarded-new-york-state-pathways-technology-early-college.

New York State Education Department. n.d. "How Are Regents Examinations Scored?" Website: https://www.nysed.gov/state-assessment/how-are-regents-examinations-scored. Accessed on August 18, 2023.

New York State Education Department. 2020. "2020-21 Charter School Basic Tuition." Website: https://stateaid.nysed.gov/charter/pdf_docs/charter_2020-2021_rates.pdf.

New York State Education Department. 2021. "NYC Public Schools at a Glance 2020-21." Website: https://data.nysed.gov/profile.php?instid=7889678368.

New York State Education Department. 2022. "Cancellation of the January 2022 Administration of the New York State (NYS) High School Regents Examination Program in Response to the Ongoing Impact of the COVID-19 Pandemic." Website: https://www.nysed.gov/sites/default/files/january-2022-regents-cancellation.pdf.

Northern, Amber M., and Michael J. Petrilli. 2019. "Aligning CTE Courses to Local Labor Markets." *State Education Standard* 19, 3: 25–29.

NYC OpenData. 2022. "Student COVID Vaccinations (2-22-2022)." Website: https://data.cityofnewyork.us/Education/Student-COVID-Vaccinations-2-22-2022-/ne9b-qgmm.

NYC P-TECH Schools. n.d. "Our Schools." Website: https://nycptechschools.org/site/node/3. Accessed on September 28, 2023.

P-TECH. n.d. "Our Schools." Website: https://www.ptech.org/our-schools/. Accessed on September 28, 2023.

P-TECH. n.d. "Learn About P-TECH's History." Website: https://www.ptech.org/about/history/. Accessed on September 28, 2023.

Reeves, Richard. 2022. *Of Boys and Men: Why the Modern Male is Struggling, Why it Matters, and What to Do About It*. Washington, DC: Brookings Institution Press.

Romano, Richard M., Rita J. Kirshstein, Mark D'Amico, Willard Hom, and Michelle Van Noy. 2019. "Adjusting College Costs for Noncredit Enrollments: An Issue for Data Geeks or Policy Makers?" *Community College Review* 47, 2: 159–177.

Rosen, Rachel, D. Crystal Byndloss, Leigh Parise, Emma Alterman, and Michelle Dixon. 2020. *Bridging the School-to-Work Divide: Interim Implementation and Impact Findings from New York City's P-TECH 9-14 Schools*. New York: MDRC.

Scrivener, Sue, Michael J. Weiss, Alyssa Ratledge, Timothy Rudd, Colleen Sommo, and Hannah Fresques. 2015. *Doubling Graduation Rates: Three-Year Effects of CUNY's Accelerated Study in Associate Programs (ASAP) for Developmental Education Students*. New York: MDRC.

REFERENCES *(CONTINUED)*

Statista Research Service. 2021. "Undergraduate Enrollment Numbers in the United States from 1970 to 2030, by Gender." Website: https://www.statista.com/statistics/236360/undergraduate-enrollment-in-us-by-gender/.

Theodos, Brett, Michael R. Pergamit, Devlin Hanson, Sara Edelstein, and Rebecca Daniels. 2016. *Embarking on College and Career: Interim Evaluation of Urban Alliance*. Washington, DC: Urban Institute.

United States Census Bureau. 2021. "States Ranked According to Per Pupil Public Elementary-Secondary School System Finance Amounts: Fiscal Year 2021." Washington, DC: United States Census Bureau.

Villavicencio, Adriana, and William H. Marinell. 2014. *Inside Success: Strategies of 25 Effective Small High Schools in NYC*. New York: Research Alliance for New York City Schools, New York University Steinhardt School of Culture, Education, and Human Development.

What Works Clearinghouse. 2017. *Standards Handbook (Version 4.0)*. Washington, DC: Institute of Education Sciences.

Zaback, Katie, Andy Carlson, and Matt Crellin. 2012. *The Economic Benefit of Postsecondary Degrees: A State and National Level Analysis.* Boulder, CO: State Higher Education Executive Officers.

EARLIER MDRC PUBLICATIONS ON P-TECH 9-14

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MDRC, a nonprofit, nonpartisan social and education policy research organization, is committed to finding solutions to some of the most difficult problems facing the nation. We aim to reduce poverty and bolster economic mobility; improve early child development, public education, and pathways from high school to college completion and careers; and reduce inequities in the criminal justice system. Our partners include public agencies and school systems, nonprofit and community-based organizations, private philanthropies, and others who are creating opportunity for individuals, families, and communities.

Founded in 1974, MDRC builds and applies evidence about changes in policy and practice that can improve the well-being of people who are economically disadvantaged. In service of this goal, we work alongside our programmatic partners and the people they serve to identify and design more effective and equitable approaches. We work with them to strengthen the impact of those approaches. And we work with them to evaluate policies or practices using the highest research standards. Our staff members have an unusual combination of research and organizational experience, with expertise in the latest qualitative and quantitative research methods, data science, behavioral science, culturally responsive practices, and collaborative design and program improvement processes. To disseminate what we learn, we actively engage with policymakers, practitioners, public and private funders, and others to apply the best evidence available to the decisions they are making.

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