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Interim Findings from the Dana Center Mathematics Pathways Long-Term Follow-Up Study

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Every year, millions of students entering college, including a disproportionate number of Black and Hispanic students, are referred to developmental (or remedial) math courses.¹ Fewer than half of these students pass through the developmental course sequence and into college-level math.² Being referred to developmental education courses is also highly correlated with dropping out of school.³ With these troubling statistics in mind, many colleges, university systems, and states have taken bold action to reform developmental education, making changes to everything from the way they assess students' college readiness to the structure and sequencing of developmental education courses. Many of these reforms are showing promising results in rigorous studies.⁴ Fewer reforms, however, have sought to address some of the most challenging problems with respect to developmental and college-level math: course content and teaching methods.

The Charles A. Dana Center at the University of Texas at Austin (Dana Center) launched the Dana Center Mathematics Pathways (DCMP) (formerly the New Mathways Project) in 2011 with the support of the Texas Association of Community Colleges. At the time, the program diversified the developmental and college-level math course content, separating it into distinct pathways

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that better aligned with students' career interests. It also streamlined the developmental math sequence, so students who tested two or more levels below college ready in math were only required to take a one-semester developmental course, and it implemented an evidence-based curricula and pedagogy to engage students in active problem solving pertinent to real-life situations. It was hypothesized that these key components would support students in ways that would make them more likely to complete the developmental math sequence, pass their first-year college-level math course, and accumulate more math credits (math completion). Changes in math completion would further help students persist in college longer and accumulate more credits (academic progress), and ultimately be more likely to earn a certificate or degree (academic success). Since the launch of this early version of DCMP, the Dana Center has continued to refine and update the program over time.

Starting in 2014, researchers from the Center for the Analysis of Postsecondary Readiness—a partnership involving the Community College Research Center at Columbia University's Teachers College and MDRC, as well as research scholars from several universities—began studying this early version of the DCMP model using a randomized controlled trial at four Texas community colleges. The colleges included El Paso Community College, Trinity Valley Community College, and two colleges from the Dallas County Community College District: Brookhaven College and Eastfield College. The study targeted students who planned to major in the social sciences or liberal arts and were referred to one or more levels of the developmental math sequence.⁵ A majority of the students in the study were Hispanic and female, and over 80 percent tested at least two levels below college ready on the math placement exam. After three semesters, this early version of DCMP was found to have a positive impact on all the measures of students' math completion (students' completion of the developmental math sequence, their likelihood of taking and passing college-level math, and the number of math credits they earned).⁶ For more information about the DCMP program studied, the study design, or the early findings, see the [2019 report](#).

The short-term findings around math completion were promising. However, the original study period did not allow for an exploration of the longer-term outcomes associated with academic progress and success. The research team has thus extended the project and undertaken a long-term follow-up study to examine the program's impacts through five years after random assignment, explore the long-term effects on subgroups of students, and conduct a cost-effectiveness analysis.

This brief presents interim findings from the long-term study for the first three years after random assignment and provides an exploratory analysis of the effectiveness of the program for various subgroups.⁷ The findings presented here show that the impacts found on math completion in the original study were sustained during the first three years, but that these impacts did not lead to impacts on students' broader academic progress or success.

As mentioned above, the Dana Center has continued to refine DCMP, and the version of the program evaluated in the study (and discussed in this brief) is different from the version of DCMP currently used in colleges across Texas and in other states. The state of Texas has also adopted new policies around developmental education. Key changes to DCMP and

the broader policy changes in Texas are discussed in more detail in the conclusion. While policy and practice have progressed in the years since the start of the study, these analyses offer a look at the longer-term effects of a program that both streamlined the developmental sequence into a single accelerated semester course and significantly changed the content and pedagogy of developmental and college-level math courses.

Findings

The findings below are organized into three categories: math completion, academic progress, and academic success. The research team conducted the analyses using data from three of the original four colleges and from the National Student Clearinghouse.⁸ The fourth college could not provide needed data and was therefore excluded from some analyses (specifically analyses related to math completion and academic progress as measured by credit accumulation). Tables in the supplement to this brief present estimates from all analyses under each of the three categories, as well as findings for different subgroups of students.

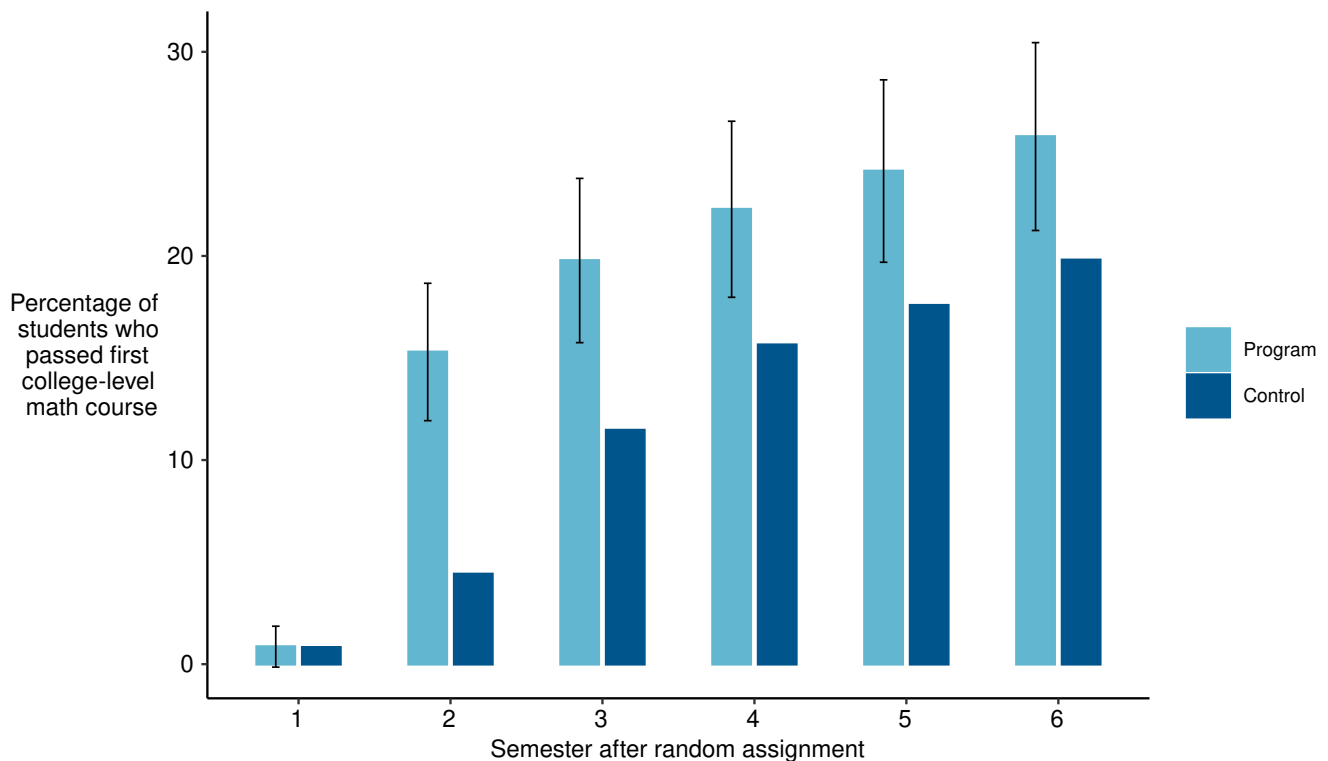
Math Completion

The early version of DCMP evaluated in this study had a positive impact on students' math completion during the first year they participated in the program, and the impacts persisted through the following two years. As shown in Figure 1, more students in the program passed their first college-level math course by the end of their second semester when compared with students not in the program (amounting to an 11-percentage point impact). By the end of the three-year follow-up period, program students were 6 percentage points more likely to have successfully completed their first course.

There are a few possible reasons for this impact. First, the version of DCMP evaluated in the study condensed two semesters of developmental math into one semester allowing many of these students to enroll in a college-level course more quickly than those not participating in the program. Second, the DCMP developmental course had a curriculum that concentrated more on student engagement and active problem solving than most non-DCMP developmental math courses. Third, the content of the developmental course was nontraditional in that it did not focus solely on basic algebraic skills but also emphasized quantitative literacy, statistics, and algebraic reasoning to prepare students for college-level courses related to their course of study. Finally, students in the program entered into a math pathway, and their first college math course was more likely statistics or quantitative reasoning, while their counterparts not in the program were more likely to take college algebra (although many did take standard statistics or quantitative reasoning courses).⁹

Students in the early version of DCMP were also more likely to successfully complete a second college-level math course in later semesters (as shown in Supplement Table S.1). Although the overall number of students who took a second college-level math course was small in both groups, many degrees in the social sciences and liberal arts, which students in the study planned to pursue, only require one math course. Consequently, this finding may suggest that the program increased students' interest in and comfort with math, thereby

Figure 1: Impact on Math Completion Over Three Years



SOURCE: Data provided by Dallas County Community College District (Brookhaven and Eastfield) and Trinity Valley Community College.
 NOTES: The errorbars represent the 90 percent confidence intervals around the impact estimates. Sample size is 949.

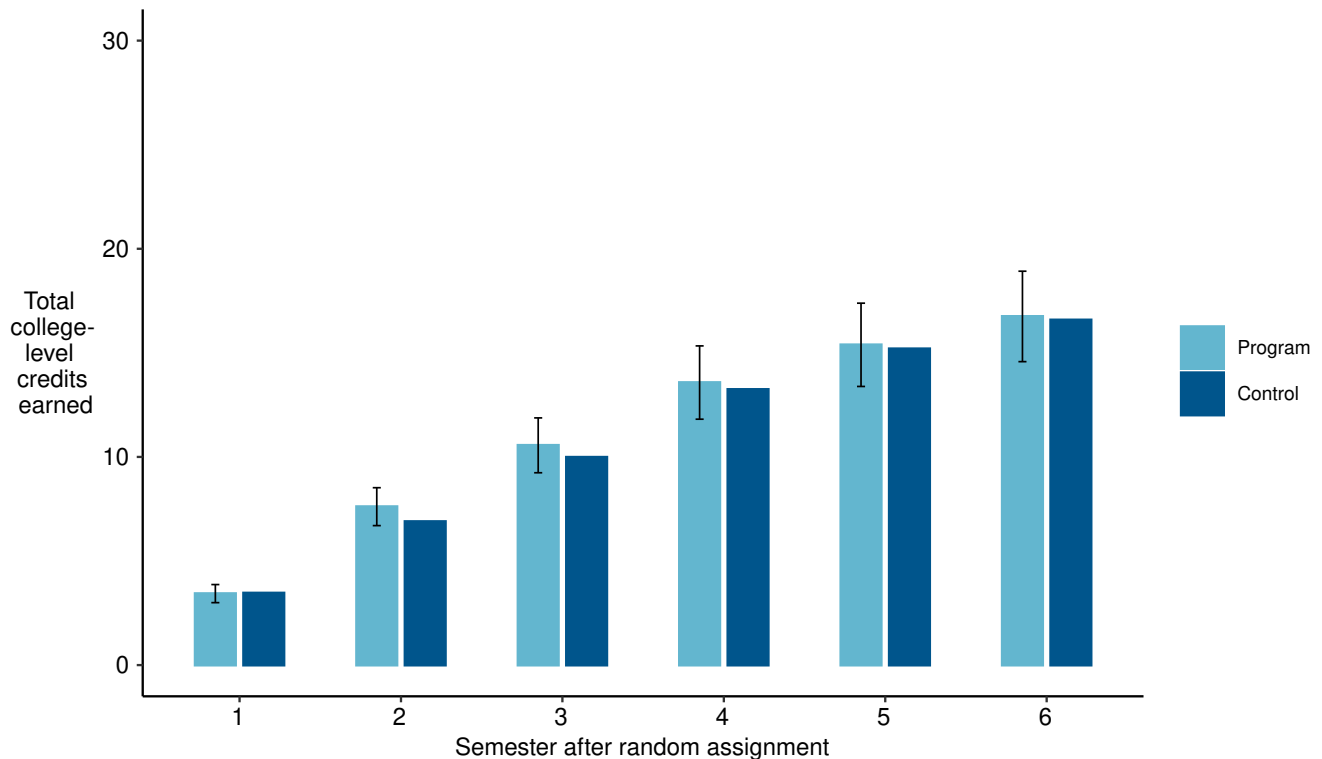
encouraging them to take and succeed in a second course. A goal of DCMP is to improve students’ understanding of the importance of math and strengthen their engagement with it, and it appears the program has had some success in this area.

Academic Progress

While students in the early version of DCMP completed college-level math courses at higher rates, this trend does not seem to have led to greater academic persistence or overall credit attainment. Students in the program and their counterparts not in the program had similar college enrollment rates during these three years. College enrollment for both groups decreased drastically over this period, and only 36 percent of program students were still enrolled in any college by the sixth semester. (See Supplement Table S.3.) There was also no difference between these two groups in credit attainment. As shown in Figure 2, students in both groups earned about the same number of college-level credits each semester.¹⁰

Academic Success

After three years, the early version of DCMP did not have an impact on students’ academic success. As shown in Figure 3, the program had no impact on students’ certificate or degree completion or transfer to a four-year college after three years. Twenty-two percent of students

Figure 2: Impact on Academic Progress Over Three Years

SOURCE: Data provided by Dallas County Community College District (Brookhaven and Eastfield) and Trinity Valley Community College.

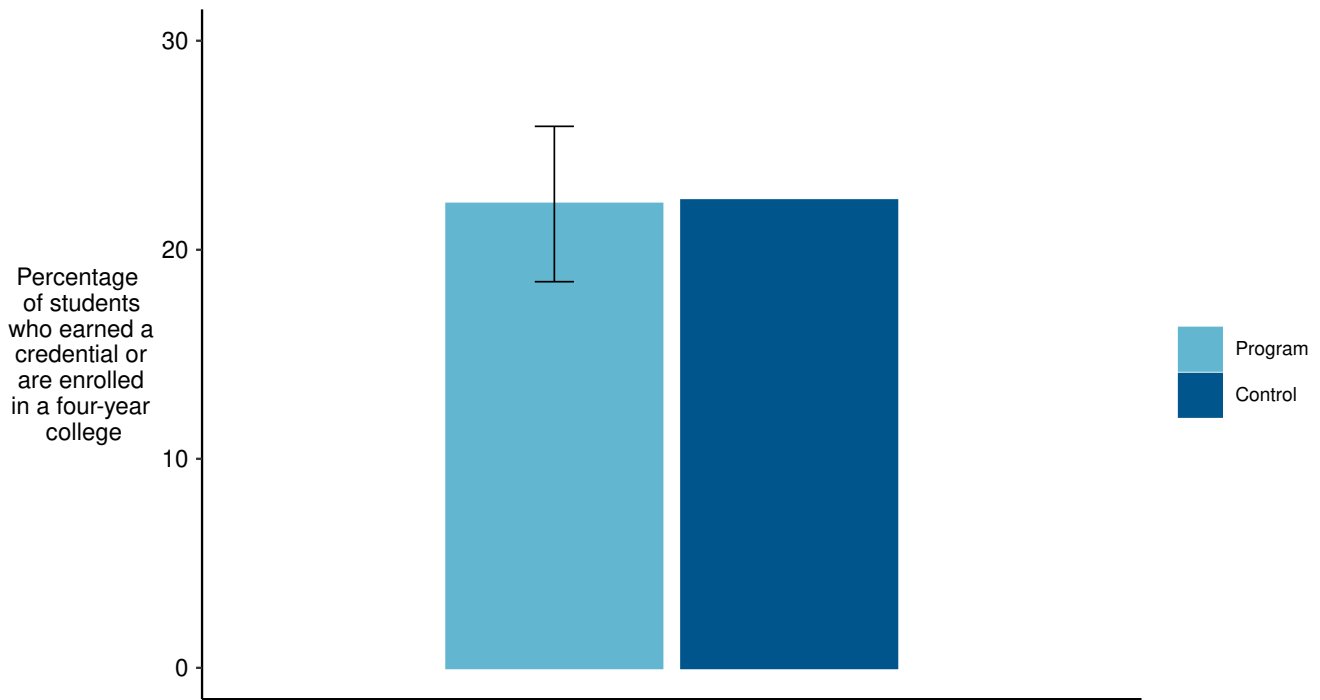
NOTES: The errorbars represent the 90 percent confidence intervals around the impact estimates. Sample size is 949.

in the program and 22 percent of those not in the program had attained a credential or were currently attending a four-year institution at the end of three years. There were also no impacts on credential completion or on transfer to a four-year college when examined separately.

Subgroups

The study investigated the effectiveness of the early version of DCMP for students that colleges have historically struggled to serve and support effectively. To this end, the study compared students who tested two to three levels below college level with students who were more college ready, students who planned to attend college part time with those who planned to attend full time, and students who did not enter college directly after graduating high school with those who did. Since Black, Hispanic, and female students all tend to be overrepresented in developmental courses, the study also explored the program's differential effects based on students' race or ethnicity and gender.¹¹ These analyses provided additional context for the impacts on the full sample, which the research team has used to generate new hypotheses for future testing. In some cases, the subgroups were small, making the subgroup analyses less reliable than the full sample analyses.

Figure 3: Impact on Academic Success After Three Years



SOURCE: Data provided by Dallas County Community College District (Brookhaven and Eastfield), Trinity Valley Community College, El Paso Community College, and the National Student Clearinghouse.
 NOTES: The errorbars represent the 90 percent confidence intervals around the impact estimates. Sample size is 1,411.

The program does not seem to have had differential effects on any of the outcomes among Black, Hispanic, and White students. The lack of differential effects suggests the intervention may be equally effective for all three groups. However, these findings should be interpreted with some caution because the samples of Black and White students were small (less than 15 percent of the full sample for each group) and almost 17 percent of the sample was missing race or ethnicity information and thus not included in the analysis. The program appears to have had no differential effects on subgroups of students based on gender, full-time or part-time enrollment status, or time of enrollment. There is little evidence from these analyses that the program is more effective for any of these groups.

However, the early version of DCMP appears to have been more effective for students assessed as needing multiple developmental courses than for students who were closer to college ready. It seems to have had a positive effect on successful completion of a first college-level math course for students who placed at least two levels below college ready, while no effect was found for students placing one level below or college ready (as shown in Supplement Table S.5).¹² This possible differential may have been partly due to the fact that only students placing two or more levels below would have experienced the intervention’s accelerated course.¹³ DCMP was originally envisioned to support students assessed as more than one level below college ready, and these students represented 84 percent of the study sample.

While the early version of DCMP appears to have supported math completion for students assessed as needing multiple developmental courses, it does not seem to have had an impact on these students' academic progress or success. The research team found no effects for this group on either of these measures. For students placing only one level below or college ready, the program appears to have negatively affected overall college credit attainment (as shown in Supplement Table S.6). The program did not reduce the number of developmental courses these students needed to take, but it is unclear why their credit attainment might have been negatively affected. Only a small number of students (16 percent of the sample) are in this group, so these findings should be considered with some caution.

Conclusion

Based on the long-term study's findings thus far, the early version of DCMP supported more students through their math course completion, but it might not have been enough on its own to sustain students through graduation. This same pattern seems to hold true for students of color and female students—groups that are often overrepresented in developmental education—as well as students with significant developmental need. To help students persist and complete a credential, the program may need to be adjusted or supplemented with other support services.

The Dana Center has been working on ways to strengthen the program's impact on math completion. Recently, the center has integrated a corequisite course structure into their pathways at some colleges. This structure further accelerates students' entrance into credit-earning courses. Instead of the one-semester developmental course described earlier, students may enter directly into a college credit course in their pathway. At the same time, those students in need of developmental assistance may receive holistic services that include a companion support course, tutoring, help from a support specialist, and other services. Since the state legislature voted Texas House Bill 2223 into law in 2017, the use of the corequisite model has spread throughout the state. The law requires colleges to offer 100 percent of developmental sections as corequisite courses starting in the 2021-2022 academic year.¹⁴ Early research on corequisite courses has shown some positive results, and a corequisite model that eliminates the developmental course altogether but keeps the math pathway sequencing and student-focused pedagogy makes sense as a next step for DCMP.¹⁵

Still, removing the math developmental education barrier may not be enough to significantly improve college completion without other support services. In the long-term study, less than one-fourth of the students in the program completed a credential or transferred to a four-year institution after three years. One option to help boost graduation rates might be to pair accelerated math pathways with multifaceted support programs. These programs use multiple components such as academic advising, tutoring, individual career and employment services, and tuition assistance over multiple years to address an assortment of barriers to students' college success. One notable example, the Accelerated Study in Associate Programs (ASAP) model, has been shown to nearly double graduation rates in multiple colleges across diverse states and for a variety of student populations.¹⁶ While programs such as DCMP can

make an important contribution, colleges may want to consider integrating math reforms with multifaceted services to meet the needs of a diverse set of students.

This brief presents interim findings for the long-term follow-up study of an early version of DCMP. A final report will assess the effects of the program after five years and will include a study of its cost effectiveness. A report on the long-term effects will include additional data sources and offer an opportunity to better assess the program's impacts on students' academic success when more students are likely to have completed associate's or bachelor's degrees.

Notes

1. Xianglei Chen, *Remedial Coursetaking at U.S. Public 2- and 4-Year Institutions: Scope, Experience, and Outcomes* (NCES 2016-405) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 2016); Morgan Taylor, Jonathan M. Turk, Hollie M. Chessman, and Lorelle L. Espinosa, *Race and Ethnicity in Higher Education: 2020 Supplement* (Washington, D.C.: American Council on Education, 2020); Xianglei Chen, Lesa R. Caves, Joshua Pretlow, Samuel Austin Caperton, Michael Bryan, and Darryl Cooney, *Courses Taken, Credits Earned, and Time to Degree: A First Look at the Postsecondary Transcripts of 2011-12 Beginning Postsecondary Students* (NCES 2020-501) (Washington, D.C.: National Center for Education Statistics, U.S. Department of Education, 2020).
2. Thomas Bailey, Dong Wook Jeong, and Sung-Woo Cho, "Referral, Enrollment, and Completion in Developmental Education Sequences in Community Colleges," *Economics of Education Review* 29, 2 (2010): 255–270.
3. Stewart Sheilynda, Doo Hun Lim, and JoHyun Kim, "Factors Influencing College Persistence for First-Time Students," *Journal of Developmental Education* 38, 3 (2015): 12–20.
4. Elisabeth Barnett, Peter Bergman, Elizabeth Mary Kopko, Vikash T. Reddy, Clive Belfield, and Susha Roy, *Multiple Measures Placement Using Data Analytics: An Implementation and Early Impacts Report* (New York: Community College Research Center, Teachers College, Columbia University, 2018); Shanna Smith Jaggars, Michelle Hodara, Sung-Woo Cho, and Di Xu, "Three Accelerated Developmental Education Programs: Features, Student Outcomes, and Implications," *Community College Review* 43, 1 (2014): 3–26; Angela Boatman, *Evaluating Institutional Efforts to Streamline Postsecondary Remediation: The Causal Effects of the Tennessee Developmental Course Redesign Initiative on Early Student Academic Success* (New York: National Center for Postsecondary Research, 2012); A. W. Logue, Mari Watanabe-Rose, and Daniel Douglas, D. "Should Students Assessed as Needing Remedial Mathematics Take College-Level Quantitative Courses Instead? A Randomized Controlled Trial," *Educational Evaluation and Policy Analysis* 38, 3 (2016): 578–598; A. W. Logue, Daniel Douglas, and Mari Watanabe-Rose, "Corequisite Mathematics Remediation: Results Over Time and in Different Contexts," *Educational Evaluation and Policy Analysis* 41, 3 (2019): 294–315; Elizabeth Zachry Rutschow, Maria Scott Cormier, Dominique Dukes, and Diana E. Cruz Zamora, *The Changing Landscape of Developmental Education Practices: Findings from a National Survey and Interviews with Postsecondary Institutions* (New York: Center for the Analysis of Postsecondary Readiness, 2019).
5. Students were enrolled in the study in four cohorts from the fall 2015 through the spring 2017 semesters.
6. Elizabeth Zachry Rutschow, Susan Sepanik, Victoria Deitch, Julia Raufman, Dominique Dukes, and Adnan Moussa, *Gaining Ground: Findings from the Dana Center Mathematics Pathways Impact Study* (New York: Center for the Analysis of Postsecondary Readiness, 2019).
7. Exploratory analyses are investigative in nature and look for suggestive evidence of the program's impacts on other outcomes of interest and for specific subgroups of students. Findings from exploratory analyses can help inform policy but should not be taken as definitive.
8. National Student Clearinghouse data included information on college enrollment and credential attainment for students from the fourth college and for students who transferred to institutions not in the study.
9. After three years, less than 5 percent of the students in DCMP had taken a college algebra course, compared with almost 13 percent of those who did not participate in DCMP. Meanwhile, 23 percent of students in DCMP had taken a statistics course during that same period, compared with 9 percent of those not in DCMP.
10. Note that by the third year, a subset of students completed credentials or transferred to other institutions where credit accumulation information is not currently available.
11. Chen (2016).

12. Only 2.6 percent of students in the full study sample were college ready.
13. Bailey, Jeong, and Cho (2010).
14. The law requires at least 25 percent of developmental courses to be corequisite in 2018-2019 academic year, at least 50 percent in 2019-2020 academic year, at least 75 percent in 2020-2021 academic year, and 100 percent starting in the 2021-2022 academic year. See the [Texas Administrative Code](#).
15. Logue, Watanabe-Rose, and Douglas (2016); Logue, Douglas, and Watanabe-Rose (2019); Florence Xiaotao Ran and Yuxin Lin, "The Effects of Corequisite Remediation: Evidence from a Statewide Reform in Tennessee" (CCRC Working Paper No. 115) (New York: Community College Research Center, Teachers College, Columbia University, 2019).
16. Susan Scrivener, Michael J. Weiss, Alyssa Ratledge, Timothy Rudd, Colleen Sommo, and Hannah Fresques, *Doubling Graduation Rates: Three-Year Effects of CUNY's Accelerated Study in Associate Programs (ASAP) for Developmental Education Students* (New York: MDRC, 2015).

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