THE PERFORMANCE-BASED SCHOLARSHIP DEMONSTRATION

MAPPING SUCCESS

Performance-Based Scholarships, Student Services, and Developmental Math at Hillsborough Community College

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October 2014

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BUILDING KNOWLEDGE TO IMPROVE SOCIAL POLICY

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Overview

In 2010, Hillsborough Community College (HCC), a large multicampus institution in Tampa, Florida, worked with MDRC to create the Mathematics Access Performance Scholarship (MAPS) program to help academically underprepared community college students succeed in developmental math. MAPS provides an incentive for low-income students referred to developmental math to take their math courses early and consecutively, get help with math in an on-campus Math Lab, and strive for passing grades or better, in exchange for a modest scholarship contingent on performance. MAPS is part of the national Performance-Based Scholarship (PBS) Demonstration, which is testing performance-based scholarships with varying student populations and program requirements.

MAPS offered eligible students the opportunity to earn a performance-based scholarship of up to $1,800 ($600 per semester for three semesters) for successfully completing a three-course sequence — comprising Beginning Algebra, Intermediate Algebra, and a first-level college math course — within a period of three consecutive semesters plus a summer term. MAPS is the only program in the PBS Demonstration that provides an incentive for a specified course sequence. MDRC used a random assignment design to study the effects of MAPS compared with HCC's standard services. Academic outcomes were tracked for all sample members for two years.

Key Findings

The findings at HCC, like those across the PBS Demonstration, are modest but positive.

- **More than 90 percent of program group students earned a MAPS award in the first semester, but scholarship receipt rates declined in the second and third semesters.** Scholarship receipt rates decreased partly because fewer students reenrolled each semester, although rates declined even after accounting for decreased enrollment.

- **MAPS students were much more likely to visit a Math Lab than control group students.** MAPS students were 38 percentage points more likely than control group students to visit a Math Lab in the first semester; a similar difference occurred in the second semester. MAPS students also spent more time in the Math Labs on average than did control group students.

- **MAPS helped move students further along in the math course sequence, and MAPS students also accumulated more credits overall — in part because of their greater progress in math.** By the end of two years, MAPS students were 11 percentage points more likely than control group students to complete a college-level math course or Intermediate Algebra as their highest-level math course (48.7 percent versus 37.8 percent). The program's estimated effect on total credit accumulation is statistically significant after one semester, after one year, and after one year and one semester. After two years, MAPS students had earned 1.6 more total credits than their control group counterparts, although the increase of 7 percent is no longer statistically significant.

- **The program had no discernible impact on students' retention.** Program group students were no more likely to reenroll in subsequent semesters than were control group students.

A future report will present a synthesis of the final results from sites across the PBS Demonstration.

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Preface

Community colleges, which serve the postsecondary needs of more than one-third of college students in the United States today, are the primary providers of remediation for students who enter college academically underprepared. Developmental (or "remedial") math is a particular challenge for community college students. In one study of more than 250,000 community college students, only 20 percent of students who were referred to developmental math passed a college-level math course — a course that is almost always required for graduation.

The Mathematics Access Performance Scholarship (MAPS) program, part of MDRC's Performance-Based Scholarship (PBS) Demonstration, serves low-income students who are referred to developmental math. The program provides an incentive for students to take their math courses early and consecutively, get help with math in an on-campus Math Lab, and strive for passing grades or better, in exchange for a modest grant contingent on performance. The findings presented in this report, from MDRC's evaluation of the MAPS program, indicate that MAPS led more students to visit a Math Lab and propelled them further in the math sequence, with a positive impact on students' registration for and completion of a college-level math course. MAPS students also accumulated more credits overall. However, some academic outcomes remain unaffected, such as student retention from semester to semester. These modest but positive findings at HCC align with those found at other colleges in the PBS Demonstration, indicating that performance-based scholarships can give students a small push in the right direction.

In general, impacts for performance-based scholarship programs are slightly more positive than for other scholarship programs found in the literature. This result may reflect the targeting of programs; on average, students in the PBS Demonstration have one or more risk factors for not completing college, such as low-income status, parenthood, or being older than traditional college age, which may contribute to the larger effect of the contingent grant on academic outcomes. Financial incentives may be especially relevant to these students. Scholarship providers may find that targeting their scholarships in purposeful ways, for instance by creating incentives for academic success or participation in student services, generates a greater return on investment than merit-based scholarship programs.

A cross-site report on the PBS Demonstration will be published in 2015. This report will include longer-term follow-up for all colleges, including HCC, and will look at patterns and impacts across colleges to draw lessons from the larger demonstration. These findings will add to the growing body of knowledge about performance-based scholarship models and the efficacy of incentives for improving academic success among low-income students.

Gordon L. Berlin
President, MDRC

Acknowledgments

The Performance-Based Scholarship (PBS) Demonstration is made possible by anchor support from the Bill & Melinda Gates Foundation. The Mathematics Access Performance Scholarship (MAPS) program and its evaluation at Hillsborough Community College (HCC) specifically were supported by the Helios Education Foundation and the Open Society Foundations. We thank our program officers at these foundations who participated enthusiastically throughout the operation of MAPS.

We would like to thank the administrators and staff members at HCC who developed and implemented MAPS. While it is impossible to name everyone who supported this project over the last few years, we want to acknowledge a few individuals. We owe special thanks to Craig Johnson, Robert Wynegar, Shannon Grinstead, Elizabeth Stewart, and Nicole Jagusztyn. Judy Alicea, the MAPS Program Coordinator, earned our gratitude repeatedly throughout the project and we want to thank her for her role in supporting the students and supporting the research. We also want to thank all the employees of HCC's Math Labs, who played an especially hands-on role in supporting the students in this study.

Many MDRC staff members have contributed to the PBS Demonstration and to this report. On the project team, we would like to recognize Lashawn Richburg-Hayes and Robert Ivry for their leadership and guidance throughout this project, and Amanda Grossman for resource management. We must also thank Joel Gordon, Galina Farberova, Shirley James, and her staff in the data room for making random assignment and baseline data collection possible. Caitlin Anzelone supported the operations effort of the program. Nikki Gurley, Melvin Gutierrez, Jonathan Rodriguez, and Camielle Headlam conducted the data checks, ensured quality control, fact-checked this report, and provided support in preparing it for publication. Gordon Berlin, Dan Bloom, Alexander Mayer, Rashida Welbeck, and Joshua Malbin reviewed drafts of this report and provided valuable feedback. Sonia Kane edited the report and Carolyn Thomas prepared it for publication. Former MDRC staff members Reshma Patel, Bethany Miller, Jed Teres, Jasmine Soltani, and Hannah Fresques also provided valuable contributions over the course of the project.

Finally, but most important, we would like to thank the hundreds of HCC math students who participated in this study. We hope that the findings from this study, and from the PBS Demonstration overall, can be used to improve college programs and services to them and others in the future.

The Authors

Executive Summary

Community colleges, which serve the postsecondary needs of more than one-third of college students in the United States today,[1] are also the primary providers of remediation for students who enter college academically underprepared.[2] According to the National Center for Education Statistics, more than two-thirds of entering community college students take at least one remedial course within six years of first enrollment.[3] Unfortunately, many students who enter a course of remediation struggle to complete that course, and only a third of students who take a remedial course in any subject earn a postsecondary degree.[4] Developmental math is a particular challenge: in one study of more than 250,000 community college students, only 20 percent of students who were referred to developmental math passed a college-level math course — a course that is almost always required for graduation.[5]

To tackle the issue of developmental math success, Hillsborough Community College (HCC), a large multicampus institution in Tampa, Florida, worked with MDRC to create the Mathematics Access Performance Scholarship (MAPS) program in 2010. MAPS is a performance-based scholarship program that provides an incentive for low-income students in developmental math to take their math courses early and consecutively, get help with math in an on-campus Math Lab, and to strive for passing grades or better, in exchange for a modest grant contingent on performance. MAPS is part of the Performance-Based Scholarship (PBS) Demonstration, a national demonstration project that is testing performance-based scholarships in a variety of settings, with different populations and varying program requirements. MAPS is

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[1]U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, "Total Fall Enrollment in Degree-Granting Institutions, by Control and Level of Institution: 1963 Through 2010," *Digest of Education Statistics* (2011): Table 199.

[2]This report uses the terms "developmental education" and "remediation" interchangeably. Although the terms may be interpreted somewhat differently, both refer to courses provided to students who are judged to be underprepared for college-level coursework.

[3]These data are based on U.S. Department of Education, National Center for Education Statistics (NCES), Beginning Postsecondary Students data from a computation using the NCES QuickStats website; see http://nces.ed.gov/datalab/quickstats.

[4]Clifford Adelman, *Principal Indicators of Student Academic Histories in Postsecondary Education, 1972-2000* (Washington, DC: U.S. Department of Education, Institute of Education Sciences, 2004); U.S. Department of Education, National Center for Education Statistics, "Percentage of Students Graduating with an Associate's Degree Within 3 Years of Entry from the 2-Year Degree-Granting Institutions Where the Students Started as Full-Time, First-Time Students," *United States Education Dashboard* (Spring 2010). Website: http://dashboard.ed.gov.

[5]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 (2010): 255-270.

an important part of the PBS Demonstration as it is the only program that provides an incentive for a specified course sequence.

After two years, the MAPS program has modestly helped students move further along the required math course sequence.

MAPS Program Model

MAPS offered students the opportunity to earn a performance-based scholarship of up to $1,800 for successfully completing a three-course sequence within a period of three consecutive semesters plus a summer term:

1. **Beginning Algebra:** a developmental math course
2. **Intermediate Algebra:** a transitional course bridging developmental and college-level math classes
3. **First level of college math:** College Algebra, Elementary Statistics, or Math for Liberal Arts, depending on student's major

The MAPS scholarship was awarded at two payment points each semester:

1. **Initial payment:** $100 was paid for remaining enrolled in the specified math course as of the end of the add/drop period (typically two weeks into the semester).
2. **Final payment:** $500 was paid for successfully completing the specified math course with a "C" or better (with the payment made after final grades had come in for the semester, typically one to two weeks after the last day of classes) and meeting Math Lab requirements as follows:
   - **Beginning Algebra:** minimum of five visits and five total hours over the course of the semester
   - **Intermediate Algebra:** minimum of three visits and three total hours over the course of the semester
   - **College-level math course:** no Math Lab requirement

In addition, students who received a grade of "B" or better in the specified math course received a **bonus award** at the end of the semester, in the form of a math textbook for the next course or a book voucher.[6]

Students who did not succeed in one of the three courses by earning a passing grade were still eligible to earn the final payment of the scholarship for that course if they reattempted and passed it within the program period.[7] Additionally, students received occasional reminders via e-mail from program staff about program requirements.

Evaluation and Research Sample

MDRC used a random assignment research design to estimate the effects of MAPS on academic outcomes. The evaluation includes an implementation study, an impact study, and a cost-effectiveness analysis.

HCC targeted its MAPS program to students who met the following criteria:

1. 18 years of age or older
2. Low-income, defined as having an Expected Family Contribution (EFC) of up to 5,273[8]
3. In need of Beginning Algebra (the highest level of developmental math)

Students who met all of the eligibility criteria and were interested in participating in the research study were randomly assigned either to a program group that was eligible to participate in MAPS or to a control group that received standard college services.

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[6]Eligible students typically received a math textbook as their bonus award for the first two courses, and a voucher for the third course.

[7]Students who attempted a course, received the initial payment of $100, and did not pass at the end of the term were able to retake the course. During the retake, students would not be eligible to receive the initial payment for enrolling, but would be eligible to receive the final payment of $500 for meeting the Math Lab and grade requirement in the course.

[8]The Expected Family Contribution is a measure of a student's and/or family's ability to contribute toward the cost of college and is calculated according to a formula established by federal law. Elements of the formula may include the family's taxed and untaxed income, assets, and benefits, such as unemployment and Social Security; the size of the family; and the number of family members enrolled in postsecondary education in the given year.

At the time of this study, students with an EFC of 5,273 or less were eligible to receive a Pell Grant.

Implementation Findings

The MAPS program was implemented at Hillsborough Community College, a two-year college with five campus locations, three satellite locations, and an active distance-learning community in Florida. The MAPS evaluation was conducted at two of HCC's largest campuses, Dale Mabry and Brandon. Both campuses had significant course offerings and established support resources (such as Math Labs) in place at the time of the study's inception to support the program, as well as the support of campus leadership necessary to implement the program.

The key findings on the implementation of MAPS follow.

- **MAPS operated largely as designed.**

Program staff fulfilled their duties as expected, and scholarship payments and book bonuses were distributed with few errors.

- **More than 90 percent of students in the program group earned a MAPS award in the first semester, but rates of scholarship receipt declined to slightly less than 60 percent in the second semester and around 30 percent in the third semester.**

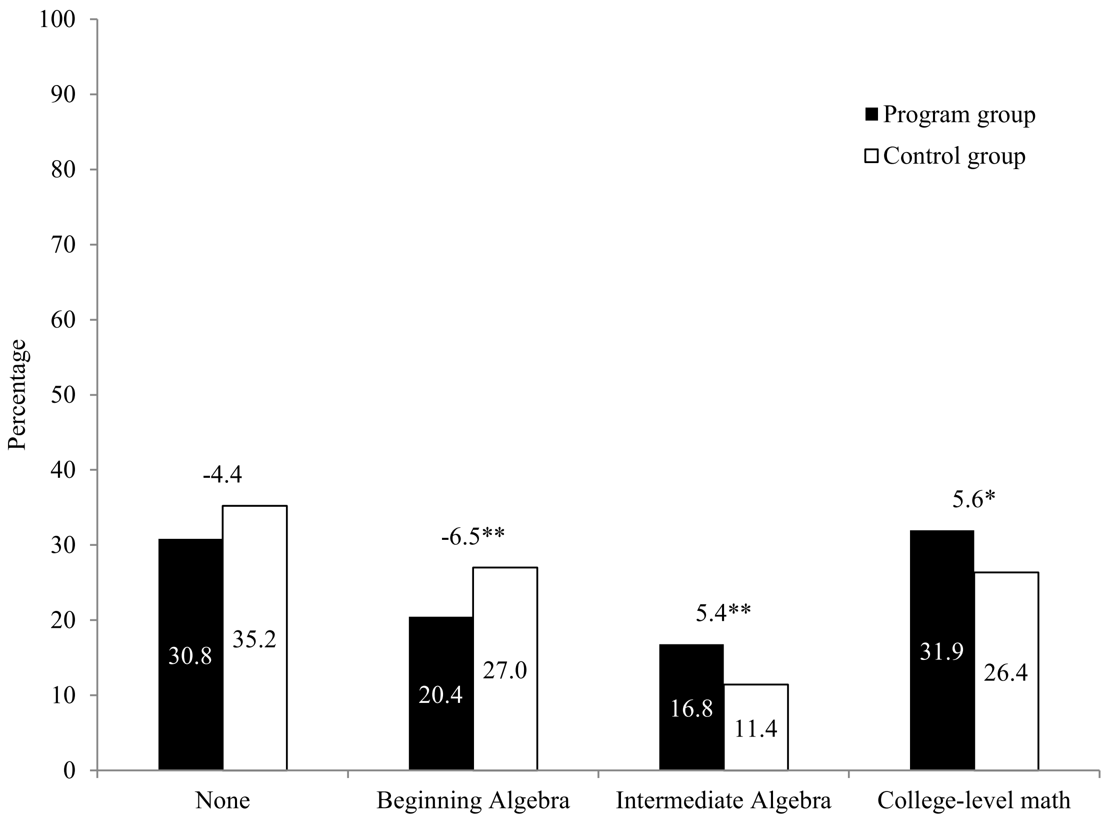
Scholarship receipt rates decreased partly as a result of fewer students reenrolling each semester: only around 80 percent and 60 percent of program group students reenrolled in the second and third semesters, respectively. However, even after accounting for students who did not reenroll at HCC, rates of scholarship receipt declined: more than 95 percent of program group students who were enrolled in the first semester received a MAPS payment, while only slightly more than 50 percent of students who were enrolled in the third semester did.

- **MAPS students were much more likely to visit the Brandon and Dale Mabry Math Labs than control group students.**

MAPS students were 38 percentage points more likely than control group students to visit the Math Labs in the first semester — 87 percent of program group students visited the Math Labs, compared with 49 percent of control group students. A similar difference occurred in the second semester. In both the first and second semesters, MAPS students also spent more time and made more visits to the Math Labs on average than control group students — more than doubling the average number of visits and average number of hours spent there by control group students.

The Performance-Based Scholarship Demonstration

Figure ES.1
Highest Level of Math Completed After Two Years
Hillsborough Community College



SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Academic Findings

Academic outcomes were tracked for all sample members for two years. The key findings are:

- **MAPS helped move students further along in the math course sequence.**

As shown in Figure ES.1, compared with their control group counterparts, MAPS students were 11 percentage points more likely at the end of two years to complete a college-level math course or Intermediate Algebra as their highest-level math course. This translates to an estimated average effect of 0.7 math credit, or a 15 percent increase in math credit accumulation (not shown in the figure).

- **There is evidence that MAPS improved students' *overall* academic progress as measured by total credit accumulation. This occurred, in part, because students made greater progress in mathematics as a result of MAPS.**

As shown in Figure ES.2, the program's estimated effect on total credit accumulation, including both math credits and credits for courses other than math, is statistically significant after one semester, after one year, and after one year and one semester. After two years, students who were offered MAPS earned 1.6 more total credits than their control group counterparts, a 7 percent increase, although this is no longer statistically significant. Taken together, this evidence suggests that MAPS improved students' overall academic progress.

Additionally, exploratory analyses suggest that MAPS may be more effective for financially independent students and for students who entered the study more than a year after graduating from high school or receiving a General Educational Development (GED) certificate. (The former group may be more likely to take responsibility for their own fiscal situation, while the latter may have been out of the math classroom for a while.) This finding will be strengthened if it is replicated at other colleges that implement performance-based scholarship programs.

- **The program had no discernible impact on students' retention.**

Over the first four semesters, MAPS had no statistically significant impact on students' semester-to-semester retention. That is, program group students were no more likely to reenroll in subsequent semesters than control group students.

- **The cost-effectiveness findings on MAPS are mixed and vary by outcome. MAPS was able to lower the cost per college-level math course completion when compared with the usual college experience but did not lower the cost of math credits and total credits earned.**

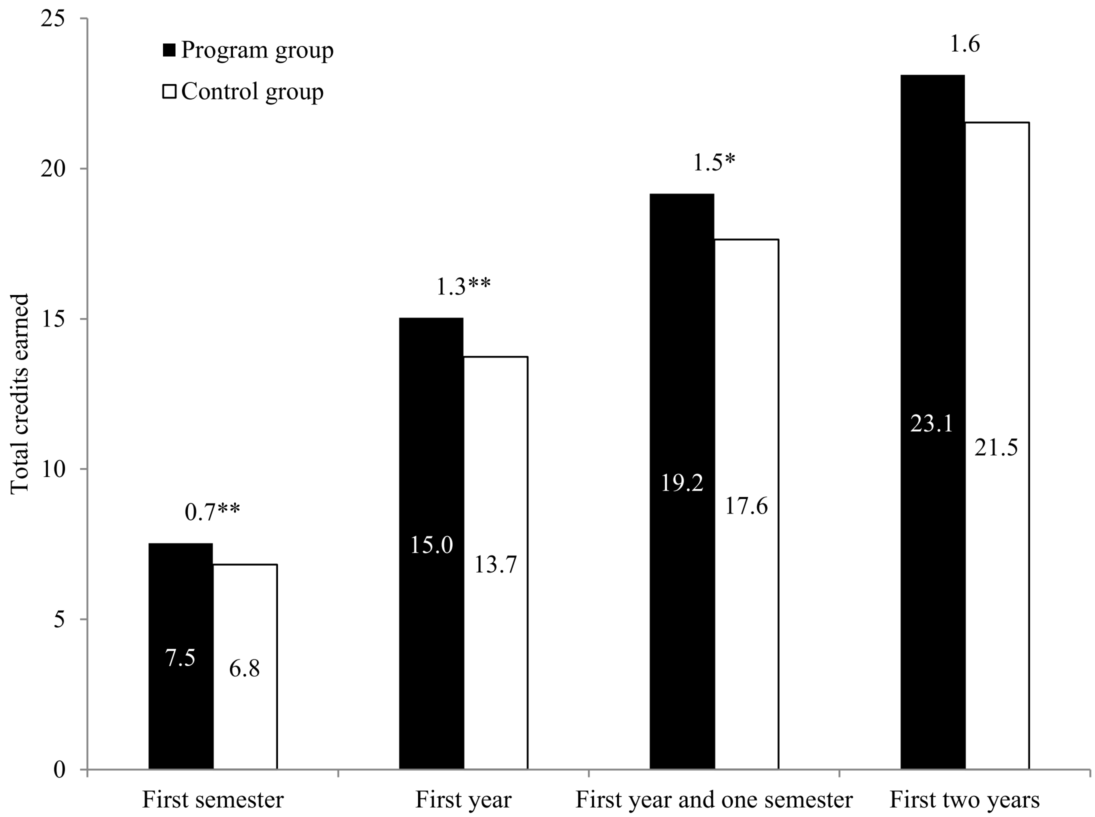
The analysis shows that the $1,394 to $1,863 of additional investment in each program group member resulted in an increase of 5.6 percentage points in the likelihood of completing a college-level math course. This impact is large enough that when costs (direct program costs plus the cost of credits attempted by students over two years) are tied to the number of college-level math course completions, the program lowers the cost per outcome achieved in comparison with the cost per outcome of the usual college services without the

The Performance-Based Scholarship Demonstration

Figure ES.2

Total Credits Earned After Two Years

Hillsborough Community College



SOURCE: MDRC calculations from Hillsborough Community College transcript data.

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A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

program. Specifically, the cost per completion of a college-level math course for the program group is up to 5 percent less than the cost per college-level math course completion for the control group. The program also resulted in students' earning 0.7 more math credit and 1.6 more credits overall; these impacts were not large enough, however, to lower the cost per math or total credits earned.

Conclusions and Next Steps

The MAPS program at HCC was designed to promote progress through a sequence of three math courses by creating incentives for enrollment, use of support services, and math performance. The findings that are reported here indicate that the program increased students' use of Math Labs and moved students further along in the math sequence — demonstrating that a program like this one can have an impact on developmental math progress. There is also evidence of modest improvement on overall academic progress. At the end of two years, the MAPS group was ahead of the control group by 1.6 credits.

The findings at HCC align with those at other colleges in MDRC's Performance-Based Scholarship Demonstration. By and large, the colleges in the demonstration have found that performance-based scholarships are able to improve some key academic outcomes, such as students' meeting the targeted academic benchmarks and earning more credits. However, some academic outcomes remain mostly unaffected, such as students' remaining in school for the next semester. The findings at HCC, and across the demonstration, are modest but positive, indicating that performance-based scholarships can give students a small push in the right direction.

A cross-college report on the PBS Demonstration will be published in 2015. That report will include longer-term follow-up for all colleges, including HCC, and will look at patterns and impacts across colleges to draw lessons from the larger demonstration. These findings will add to the growing body of knowledge about performance-based scholarship models and the efficacy of incentives for improving academic success among low-income students.

Chapter 1

Introduction

Community colleges, which serve the postsecondary needs of more than one-third of college students in the United States today,[1] are also the primary providers of remediation for students who enter college academically underprepared.[2] According to the National Center for Education Statistics (NCES), more than two-thirds of entering community college students take at least one remedial course within six years of first enrollment.[3] Unfortunately, many students who enter a course of remediation struggle to complete that course, and only a third of students who take a remedial course in any subject earn a postsecondary degree.[4] Developmental math is a particular challenge for community college students. In one study of more than 250,000 community college students, only 20 percent of students who were referred to developmental math passed a college-level math course — a course that is almost always required for graduation.[5]

Administrators at Hillsborough Community College (HCC), a large multicampus institution in Tampa, Florida, found that many of their students struggled to get through developmental math and pass the college-level math courses needed for graduation. They worried that math was presenting an insurmountable obstacle for many students. To address this problem, HCC worked with MDRC in 2010 to create the Mathematics Access Performance Scholarship (MAPS) program. MAPS is a performance-based scholarship program that provides an incentive for low-income students in developmental math to take their math courses early and consecutively, get math help in an on-campus Math Lab, and strive for passing grades or better in exchange for a modest grant contingent on performance. The hope was that getting students through the developmental math sequence and a college-level math course would help them overcome the obstacle that math had been presenting and receive a credential.

MDRC evaluated MAPS using a random assignment design (explained below), widely considered to be the gold standard in social science research. After two years, MDRC found that

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[1]U.S. Department of Education, National Center for Education Statistics (2011).

[2]This report uses the terms "developmental education" and "remediation" interchangeably. Although the terms may be interpreted somewhat differently, both refer to courses provided to students who are judged to be underprepared for college-level coursework.

[3]Based on U.S. Department of Education, National Center for Education Statistics, Beginning Postsecondary Students data from a computation using the NCES QuickStats website (http://nces.ed.gov/datalab/quickstats).

[4]Adelman (2004).

[5]Bailey, Jeong, and Cho (2010).

MAPS has modestly helped students move further along the required math course sequence. This report covers the background of HCC's MAPS program, the program's implementation, the impacts of the program on students' academic progress, and the cost-effectiveness of the program.

National Performance-Based Scholarship Demonstration

MAPS is part of a demonstration project that is testing various performance-based scholarship programs at eight institutions and one intermediary across the country. MDRC launched the Performance-Based Scholarship (PBS) Demonstration in 2008 to test an innovative strategy for addressing two policy objectives: increasing financial support available to low-income students and creating an incentive for such students to complete their courses and make more timely progress toward degrees. The idea is to provide a supplement to existing federal and state financial aid that is contingent on enrolling in a minimum number of credit hours and achieving passing grades, among other requirements.

Supported by a consortium of funders, partners, and postsecondary institutions, the PBS Demonstration is based on positive findings that emerged from MDRC's Opening Doors Demonstration in Louisiana, which showed that such an incentive-based scholarship program had a number of positive effects for students, including boosting students' credit accumulation, grades, and persistence. While the Louisiana results were impressive, there was an open question about whether performance-based scholarships would be effective in other college settings, for different target groups of students, or with different aid amounts. The national PBS Demonstration tests these variations. Box 1.1 highlights the key principles of performance-based scholarships.

The early results from other sites in the PBS Demonstration show modest but positive effects on important markers of academic progress, including increases in credits earned and an increase in the proportion of students who meet the scholarship grade and credit requirement.[6] In some sites, the programs also reduced the amount of debt that students took on during the program semesters. The short-term results of the demonstration suggest that performance-based scholarships can have an impact on some important markers of academic success.

[6]Patel, Richburg-Hayes, de la Campa, and Rudd (2013).

Box 1.1

Key Principles of Performance-Based Scholarships

The programs in the PBS Demonstration vary by target population, performance benchmarks, scholarship amounts, and the integration of student services (among other things). But all of the programs incorporate the following key principles:

- Awards are paid if students meet basic conditions regarding enrollment and grades in college courses. The awards thus act as incentives, rewarding behavior associated with academic success.
- The scholarships are paid to students based on their academic performance in the current term, regardless of their performance in previous terms. This is unlike merit-based aid, for which students have to first qualify based on their high school performance (for example, high school grade point average) or grades from a previous college term.
- To reinforce the incentive nature of these scholarships, they are paid directly to students rather than to institutions. Students can use the money to cover any expenses, including those that could derail continued attendance and success (for example, child care or transportation needs).*
- Performance-based scholarships are designed as a supplement to Pell Grants and state aid to help meet the needs of low-income students. In other words, the intervention gives students more money to cover academic and living expenses, and can potentially reduce their dependence on loans.†

NOTES: *Financial aid that covers tuition and fees involves a transfer from the financial aid office to the university rather than a direct payment to the student. While a reduction in the amount owed to the university should theoretically mean the same to a student as a check, economic experimentalists and behaviorists have long appreciated the salience of actual, tangible cash in hand.

†Financial aid regulations prohibit students from receiving financial aid in excess of their need. (Such excess aid is considered income.) In cases where students' full cost of attendance is met by financial aid that has already been awarded, federal work-study or loans may be displaced by the performance-based scholarship.

Creating a Developmental Math Intervention at Hillsborough Community College

The Mathematics Access Performance Scholarship program originated from an analysis of student data by administrators at HCC. The administrators were concerned about the lack of success experienced by the majority of HCC students who tested into developmental mathematics. HCC offers three math classes below the college level: College Prep Math, the first and lowest level of developmental math; Beginning Algebra, the second and highest level of developmental math; and Intermediate Algebra, a transitional course between developmental and college-level math.[7]

The Associate in Arts degree at HCC requires students planning to transfer to a four-year institution to take two college-level math courses. This adds up to four math courses for students who start at the highest level of developmental math and five math courses for students who start at the lowest level of developmental math. According to HCC's historical data, fewer than 10 percent of students who enrolled in Beginning Algebra in fall 2007 had completed one college-level math course by fall 2008.[8] With so few students advancing through a college-level math course, HCC administrators were motivated to work with MDRC to design an intervention to help more students get through their math requirements.

To address low rates of completion of developmental math at HCC, administrators identified a number of factors that they believed significantly contributed to their students' lack of progress — and that HCC could try to address. These factors included (1) students' reluctance to enroll in math courses early; (2) students' reluctance to take math courses continuously; and (3) students' lack of exposure to and use of academic support services.

HCC's priorities are supported by research. Many of the students who fail to complete their assigned developmental sequence do so, in part, as a result of not starting the sequence in the first place.[9] Simply getting students into the sequence may have impacts on their success. HCC administrators also believed that encouraging students to take their sequenced courses continuously would help them complete the courses. Their intent was to help students avoid "learning loss," or the loss of academic knowledge and skills during periods away from school, which is well documented in the education literature on kindergarten through twelfth grade (K-12) for long breaks like summer.[10] In this literature, learning loss has been shown to be even worse for students of color and other at-risk groups.[11] The same may hold true for postsecondary students: The longer the time that passes between sequential math courses, whether between

[7]Developmental courses do not provide college-level credits required for graduation. Intermediate Algebra, a transitional course, provides students with college-level elective credits but does not provide college-level math credits.

[8]This calculation includes only students who passed Beginning Algebra in fall 2007, Intermediate Algebra in spring 2008, and a college-level math course in fall 2008. These requirements may have resulted in HCC's historical calculation showing a lower proportion of students passing college-level math compared with the proportion of MAPS control group students shown in Chapter 4; the MAPS calculation did not have comparably strict requirements.

[9]Bailey, Jeong, and Cho (2010).

[10]Cooper (2003).

[11]Rock, Pollack, and Weiss (2004).

high school and college or between college courses, HCC administrators reasoned, the less likely students would be to retain the key knowledge and skills they need.

Additional math help in the form of supplemental instruction, practice, and tutoring has been identified as a key support for students in developmental math courses.[12] Tutors may be housed in colleges in one of two ways: in a stand-alone tutoring program or in a learning assistance center, which provides a number of supports for students' learning.[13] Learning assistance centers offer an array of services for students in need of support, such as tutoring and computer-assisted instruction.[14] In developmental education specifically, both of these have been identified as promising practices for increasing completion rates among community college students.[15] HCC already offered students these services in a centralized location — the Math Lab — and wanted students to make better use of this resource.

These factors are addressed by the MAPS design, which provides students with financial incentives to take their math courses early, seek out math assistance, pass their courses, and immediately enroll in the next course in the sequence.

MAPS Program Model

MAPS was designed to connect developmental math students with HCC's academic support services and to improve their performance in math courses by creating incentives for making choices that lead to academic success. The program was also meant to provide financial relief to the low-income students it targeted. The program made no changes within the classroom and can be considered "light-touch," given that the only interaction between program coordinators and students in the program consisted of occasional reminders via e-mail about program requirements.

MAPS offered students the opportunity to earn a performance-based scholarship of up to $1,800 for the successful completion of a three-course sequence (as shown in Figure 1.1):

1. **Beginning Algebra:** a developmental math course
2. **Intermediate Algebra:** a transitional course bridging developmental and college-level math classes

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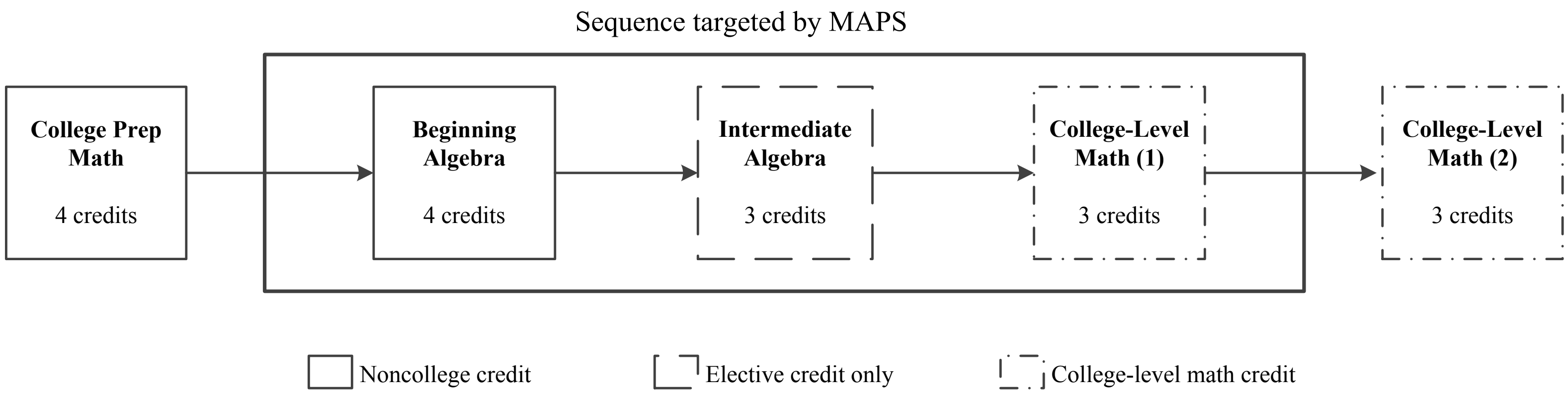
[12]Fullmer (2012); Council for the Advancement of Standards in Higher Education (2010); Rheinheimer, Grace-Odeleye, Francois, and Kusorgbor (2010); Perin (2004).
[13]Rutschow and Schneider (2011).
[14]Perin (2004); Stern (2001).
[15]Bassett and Frost (2010).

The Performance-Based Scholarship Demonstration

Figure 1.1

Hillsborough Community College Math Progression



SOURCE: Hillsborough Community College course catalog.

NOTE: All sample members were eligible to enroll in Beginning Algebra at baseline. HCC students typically need two college-level courses to receive an Associate in Arts degree. The first college-level math course that students take may be College Algebra, Elementary Statistics, Topics in Mathematics, or Explorations in Mathematics. For their second college-level math course, students may take another of those four courses, or one of several more advanced courses not listed here.

3. **First level of college math:** College Algebra, Elementary Statistics, or Math for Liberal Arts, depending on the student's major

The MAPS scholarship was awarded at two payment points each semester:

1. **Initial payment:** $100 was paid for remaining enrolled in the math course as of the end of the add/drop period (typically two weeks into the semester).

2. **Final payment:** $500 was paid for successfully completing the math course with a "C" or better (with the payment made after final grades had come in for the semester, typically one to two weeks after the last day of classes) and meeting Math Lab requirements as follows:

   - **Beginning Algebra:** minimum of five visits and five total hours over the course of the semester[16]

   - **Intermediate Algebra:** minimum of three visits and three total hours over the course of the semester

   - **College-level math course:** no Math Lab requirement

In addition, students who received a grade of "B" or better in the specified math course received a **bonus award** at the end of the semester, in the form of a math textbook for the next course or book voucher.[17]

The initial payment was designed to get money into students' hands early so that they could spend it on early semester expenses, such as textbooks. The first payment also functioned to make the scholarship seem "real" to students, a tangible reminder of the program and what was available to them. Students earned this payment by still being enrolled in the proper math course through the end of the add/drop period. (For the fall and spring semesters, this date falls at the end of the first week of class; during the summer semester, this period is the second day of class.)

The final payment was designed to offer an incentive for students to use the campus Math Labs and pass the math course in which they were enrolled. The grade benchmark for

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[16]In setting these benchmarks, MDRC relied on lessons learned from evaluating two student success courses with required visits to "Success Centers" that operated at Chaffey College in 2005-2007. Student success courses teach students how to navigate the college environment through goal setting, study skills, college regulations, and so forth. See Scrivener, Sommo, and Collado (2009).

[17]Eligible students typically received a math textbook as their bonus award for the first two courses, and a voucher for the third course.

earning the scholarship was set at the passing rate of "C." Additionally, in the first two courses in the sequence, students had to visit the Math Labs a minimum number of times and for a minimum number of hours in order to receive the final payment. HCC's Math Labs are math-focused resource centers staffed by trained tutors that offer a range of activities for students, including one-on-one tutoring, group tutoring sessions, and online math instruction. The Math Labs and students' usage are described in more detail in Chapter 3.

The bonus award, given to students who not only pass their course but earn a grade of "A" or "B," was designed to motivate students to aim higher. Earning a textbook for the next math course was intended to further motivate students to continue on in the sequence in the following semester, since the cost of math textbooks (approximately $150 to $200) can be prohibitive. Some students may not buy books at all, which puts them at an academic disadvantage. Having the cost of a textbook covered before the semester starts was theorized to be a factor that would motivate students to enroll in the next course.

MAPS was designed to encourage students to complete the three-course sequence within a period of three semesters and one summer semester (referred to in this report as the "study period"). The modest flexibility implicit in this four-semester time frame was intended to be responsive to the realities of students' lives (for instance, students may need to work or care for their children over the summer), while still encouraging persistence in mathematics. In addition, students who did not succeed in one of the three courses by earning a passing grade were still eligible to earn the final payment of the scholarship for that course if they reattempted it and passed. Multiple chances at the course and the final scholarship payments were intended to help motivate students to reenroll and persist in mathematics.[18]

MAPS was designed so that students were paid directly, receiving their payments on bank cards that they could use on campus or take to a bank to withdraw cash.[19] This is a core element of MDRC's performance-based scholarship model. Paying the scholarships directly to students allows them to use the funds at their discretion. Students can choose for themselves which expenses are most pressing, whether they be educational, such as textbooks or tutoring, or personal, such as transportation or child care. All these expenses can be barriers to successful academic progress or completion.

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[18]Students who attempted a course, received the initial payment of $100, and did not pass at the end of the term were able to retake the course. During the retake, the student would not be eligible to receive the initial payment for enrolling, but would be eligible to receive the final payment of $500 for meeting the Math Lab and grade requirement in the course. The maximum scholarship award per course was $600, regardless of the number of attempts a student made for each course.

[19]These cards, called "HCC One" cards, are used to disburse all financial aid refunds to students at HCC.

Theory of Change

Why might performance-based scholarships combined with required Math Lab visits be expected to lead to better outcomes for students? A logic model depicting the theory of change for the MAPS program is shown in Figure 1.2. Drawing on behavioral economics and discussions with financial aid experts, MDRC postulated that performance-based scholarships might influence students' thinking and behavior in several ways.[20] First, the benchmarks required to earn the money may motivate students to enroll in math immediately and continuously, make use of the Math Labs to get the extra support they need, and work harder at earning good grades. Second, receipt of a scholarship may help students to keep employment to a reasonable level and to devote more time to school. Third, receipt of a scholarship may help students cover necessary expenses associated with going to college — from books and supplies to transportation — and thereby increase their odds of success.

If students respond to the scholarships in the ways outlined above, they are expected to meet the conditions of the performance-based scholarship, feel increased confidence in their ability to succeed, and feel lower levels of stress about money while in college. They are also expected to have reduced or eliminated the math coursework required to earn a credential. These short-term outcomes may lead to greater persistence in college and a shorter time to earn a degree. Ultimately, these behavioral changes are postulated to lead to higher graduation rates. Performance-based scholarships are predicated on the idea that relatively modest supplements to financial aid can provide needed help and lead to better academic outcomes.

MDRC's Evaluation of MAPS

MDRC's evaluation of MAPS uses a random assignment design to estimate the effects of the program on service usage and academic outcomes. Widely considered to be the gold standard in social science research, random assignment results in this context in two groups of students who are similar at the outset of the study in regard to both their observable characteristics (race, gender) and unobservable ones (motivation, personal obstacles). As a result, any subsequent differences in (or "impacts" on) outcomes between the two groups can be confidently attributed to MAPS.

There are limits to this design, however. MAPS involves multiple components offered as a package to program group students. This study examines whether that package affects

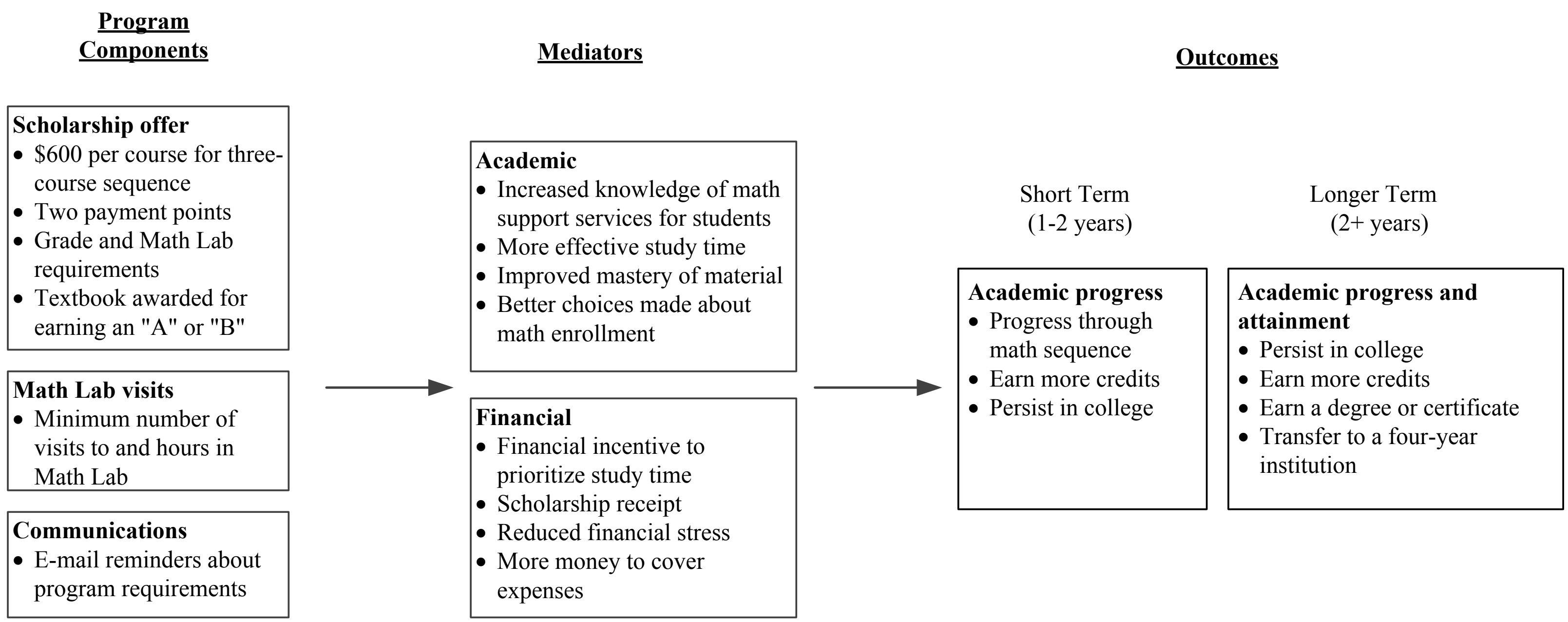
[20]MDRC used guidance from the large literature on stereotype threat (Steele and Aronson, 1995) and discussions with noted cognitive psychologist Edward Deci on motivation in developing the conceptual framework.

The Performance-Based Scholarship Demonstration

Figure 1.2

Theory of Change for the Mathematics Access Performance Scholarship Program

Hillsborough Community College



student outcomes, but it cannot disentangle the impacts of individual components such as Math Lab visits or scholarship payments. Rather, the evaluation produces a reliable estimation of the impact of the program as a whole.

The evaluation seeks to answer the following key research questions:

- How was MAPS implemented and was it implemented as designed?
- Did the program increase students' Math Lab usage and scholarship receipt?
- Does the opportunity to participate in MAPS improve students' academic progress?
- What does MAPS cost? Is it a cost-effective strategy to achieve the desired academic outcomes?

The Remainder of the Report

This report discusses the program's implementation and its impacts on student achievement. Chapter 2 provides more detail on the HCC campus, as well as information about the random assignment process, data sources used in the evaluation, and baseline characteristics of the sample. Chapter 3 reports on the implementation of MAPS, student outcomes regarding service use, and scholarship receipt. Chapter 4 examines the academic impacts of the program. Chapter 5 explores the costs and cost-effectiveness of the program. Chapter 6 concludes the report by summarizing findings and discussing where the field is heading in terms of developmental education reform.

Chapter 2

Background and Data Sources

MDRC's evaluation of the Mathematics Access Performance Scholarship (MAPS) program uses a random assignment design to test the effectiveness of a performance-based scholarship in improving performance in a math course sequence. This chapter provides information about the college and the target population, discusses the random assignment process, presents characteristics of the study sample members, and outlines the data sources used in the report for the implementation, impact, and cost analyses.

The College

The MAPS program was implemented at Hillsborough Community College (HCC) in Florida. Located in the greater Tampa metropolitan area, HCC is a two-year college with five campus locations, three satellite locations, and an active distance-learning community (students who are studying remotely). Among the larger community colleges in the state of Florida, HCC serves a diverse population of more than 46,000 students throughout Hillsborough County each year.

The MAPS evaluation was conducted at two of HCC's largest campuses, Dale Mabry and Brandon. The administration at HCC wanted MAPS to reach a significant portion of the college population while keeping the program centrally located. Both campuses had significant course offerings and established resources (such as Math Labs) in place at the time of the study's inception; they also had the support of campus leadership for the program.

Dale Mabry Campus is the college's oldest and largest campus, located in the urban community of Drew Park in the heart of Tampa. This campus is home to nearly half of HCC's student population. Career and technical programs in health, computer science, business, hospitality and tourism management, and culinary arts are located at Dale Mabry. Additionally, it is home to many of the college's student services and resources, including HCC's Dental Clinic, intercollegiate athletic programs, and student housing facilities.

Brandon Campus is located in Brandon, a suburb of Tampa, and primarily serves the central portion of Hillsborough County. Though the campus has broad course offerings within both Associate of Arts and Associate of Science programs, it excels in science, technology, engineering, and mathematics (STEM) curricula. Among HCC's campuses, Brandon is positioned as the center for technology, research, and science education.

The Target Population

The study at HCC targeted both new and continuing students in need of the highest level of developmental math, Beginning Algebra. In order to be eligible for the MAPS study, students were required to be:

- 18 years of age or older
- Low-income, defined as having an Expected Family Contribution[1] (EFC) of 5,273 or less
- In need of Beginning Algebra, which included the following three groups of students:
  - Students who had successfully completed the first level of developmental math, College Prep Math, and were ready to move on to Beginning Algebra
  - Students who placed directly into Beginning Algebra
  - Students who had not successfully completed Beginning Algebra and were required to retake the course

These requirements were chosen specifically to reach a wide range of students believed by college administrators to be at high risk for not completing the developmental math sequence. Administrators hoped that, with MAPS, the students could potentially complete the three-course sequence within three semesters and one summer term, and that the scholarship could help them with the cost of postsecondary education.

Recruitment and Random Assignment

MAPS operated at HCC from fall 2010 through fall 2012. The study sample was recruited over three time periods — before the start of the fall 2010, spring 2011, and fall 2011 semesters — producing three cohorts of students. The program period lasted three semesters plus one summer semester for each cohort. A total of 1,075 students were randomly assigned into the study: 336 students in the fall 2010 cohort, 327 students in the spring 2011 cohort, and 412

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[1]The EFC is a measure of a student's or family's ability to contribute to the cost of college and is calculated according to a formula established by federal law. Elements of the formula may include the family's taxed and untaxed income, assets, and benefits, such as unemployment and Social Security; the size of the family; and the number of family members enrolled in postsecondary education in a given year.

students in the fall 2011 cohort. Sixty-two percent of students were randomly assigned to the program group and 38 percent were assigned to the control group.[2]

HCC staff in the office of institutional research identified eligible students using a database housed in their department. Eligible students received letters by postal mail and e-mail inviting them to an information session about the program and requesting a reply. The invitation letter briefly described the program and informed students that, because there were a limited number of slots, students who came to the information session would be selected by lottery to enroll in the program.

HCC held multiple information sessions during each round of random assignment. During these sessions, college staff explained how MAPS worked, what was required of students, and the purpose of the study. Students who wished to participate in the study were asked to sign an "informed consent" form detailing the terms of their participation in the study, including a description of the data that would be collected and analyzed. Before they were randomly assigned, students were also required to fill out a baseline information form (BIF), which asked for background information such as students' age, race and ethnicity, marital status, prior educational experience, and current financial and employment situation. Students were notified of their research group status immediately after filling out the informed consent form and the BIF. If students were not already registered for Beginning Algebra, they had the option to register for a class at that time.

Since these courses are often oversubscribed, HCC administration reserved a number of seats in Beginning Algebra courses at both Dale Mabry and Brandon campuses for study participants to ensure that students who enrolled in the study were able to take the first math course in the sequence. Both program and control group students were able to take advantage of the reserved seats; as a result, reserved seats are not part of the intervention being studied. As students were recruited into the study, staff found that most students who came to information sessions and showed interest in joining the study had already registered for Beginning Algebra. As the start of the semester neared, the reserved seats that were unused were released gradually to the general student body to ensure that students in need of the course outside of the study were able to register. For the second and third courses in the sequence, no seats were held for students.

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[2]A random assignment ratio of 3:2 was used.

Sample Characteristics

Table 2.1 presents some demographic and other background characteristics for the full MAPS study sample. (See Appendix Table A.1 for a comparison of program and control group students.)

The majority of sample members, roughly 66 percent, are female. The sample comprises white, black, and Hispanic students equally; there is no racial majority. The average age of the sample at the time of random assignment was 27 years, reflecting the fact that the majority of students were not of traditional college age. The majority of students were unmarried, and around 44 percent had at least one child. Nearly 40 percent of students were receiving some form of government benefits. About half the students reported being employed at the time of random assignment, and of those, roughly 70 percent were working more than 20 hours per week. The majority of students intended to attend HCC full time (12 or more credits) in their first semester of the program. One-third of the students are the first in their families to attend college and about 25 percent reported speaking a language other than English regularly at home.

To assess the representativeness of the sample, Table 2.2 presents background and demographic characteristics for the study sample compared with the general HCC population and the MAPS-eligible population.[3] The data show that MAPS-eligible students include a higher proportion of females than does the general HCC student population. The general student population at HCC is nearly 50 percent white and roughly 25 percent each Hispanic and black, while the study sample is more evenly distributed among the three racial categories. Roughly 20 percent of MAPS-eligible students were enrolling in college for the first time, approximately twice the percentage in HCC's overall student population.

Compared with the population of HCC students who were eligible for MAPS, the study sample looks quite similar. They match closely in gender and race. The study sample was slightly older and slightly more likely to be in their first semester in college, although these differences were quite small.

Data Sources

Several data sources are used in the analysis and presented in this report.

- Baseline data: Baseline Information Forms (BIFs) were completed by all study participants before they were randomly assigned. The questionnaire asked

[3]Data for the study sample come from the BIF. HCC provided the information on the general HCC population and MAPS-eligible population.

The Performance-Based Scholarship Demonstration

Table 2.1

Selected Characteristics of Sample Members at Baseline

Hillsborough Community College

Characteristic	Full Sample
Gender (%)	
Male	33.7
Female	66.3
Age (%)	
18-19 years old	23.3
20-23 years old	23.6
24-26 years old	12.9
27-30 years old	11.5
31 years and older	28.6
Average age (years)	27.0
Race/ethnicity[a] (%)	
Hispanic	30.7
White	30.5
Black	33.1
Asian or Pacific Islander	1.2
Other	4.4
Married (%)	17.9
Missing	9.5
Number of children (%)	
0	56.1
1	17.4
2	12.5
3 or more	14.0
Household receiving any government benefits[b] (%)	38.0
Missing	12.6
Financial dependence[c]	
Independent	60.7
Dependent	34.2
Missing	5.1
Currently employed (%)	50.8
Among those currently employed:	
Number of hours worked per week in current job (%)	
1-10 hours	*4.0*
11-20 hours	*24.0*
21-30 hours	*21.5*
31-40 hours	*47.1*
More than 40 hours	*3.4*

(continued)

Table 2.1 (continued)

Characteristic	Full Sample
Highest grade completed (%)	
10th grade or lower	13.9
11th grade	8.2
12th grade	77.9
Diplomas/degrees earned[d] (%)	
High school diploma	75.4
GED certificate	26.3
Occupational/technical certificate	13.7
Associate's degree or higher	1.3
None of the above	0.1
Date of high school graduation/GED receipt (%)	
During the past year	18.5
Between 1 and 5 years ago	31.9
Between 5 and 10 years ago	18.9
More than 10 years ago	30.7
First semester at any college or university (%)	23.7
Expected enrollment in coming semester (%)	
Full time (12 credits or more)	69.6
Part time (6 to 11 credits)	28.3
Less than part time (less than 6 credits)	2.1
Main reason for enrolling in college[d] (%)	
To complete a certificate program	1.9
To obtain an associate's degree	49.0
To transfer to a 4-year college/university	47.5
To obtain/update job skills	2.8
Other	0.9
First person in family to attend college (%)	33.3
Language other than English spoken regularly in home (%)	25.6
Sample size	1,075

SOURCE: MDRC calculations from Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences.
Characteristics shown in italics are calculated for a proportion of the full sample.
Missing values are only included in variable distributions for characteristics with more than 5 percent of the sample missing.
[a]Respondents who said they are Hispanic and chose a race are included only in the Hispanic category. Respondents who said they are not Hispanic and chose more than one race are included in the Other category. These respondents, combined with those who said they were American Indian or Alaska Native, or another race/ethnicity, are included in Other.
[b]Benefits include unemployment/dislocated worker benefits, Supplemental Security Income or disability, cash assistance or welfare, food stamps, and Section 8 or public housing.
[c]Students were counted as financially independent if they met any one of the following criteria as of random assignment: they were age 24 years or older, they were married, or they had one child or more.
[d]Distributions may not add to 100 percent because categories are not mutually exclusive.

The Performance-Based Scholarship Demonstration

Table 2.2

Selected Characteristics of HCC's Student Population Compared with MAPS Target Population and MDRC Evaluation Sample: Fall 2010, Spring 2011, and Fall 2011 Semesters

Hillsborough Community College

Characteristic	All HCC Students[a]	MAPS-Eligible Students[b]	Evaluation Sample
Gender (%)			
Male	44.0	37.3	33.7
Female	56.0	62.7	66.3
Age (%)			
Younger than 18	3.7	0.0	0.0
18-19 years old	21.1	28.2	23.3
20-23 years old	28.8	28.3	23.6
24-26 years old	11.3	12.5	12.9
27-30 years old	10.4	10.6	11.5
31 years and older	24.7	20.4	28.6
Average age (years)	26.9	25.7	27.0
Race/ethnicity (%)			
Hispanic	25.6	29.3	30.7
White	47.1	31.1	30.5
Black	22.1	36.2	33.1
Asian or Pacific Islander	3.7	1.5	1.2
Other	1.5	1.8	4.4
Diplomas/degrees earned (%)[c]			
High school diploma	70.9	73.8	75.4
GED certificate	8.8	20.6	26.3
Occupational/technical certificate	2.9	1.2	13.7
Associate's degree or higher	5.3	0.1	1.3
None of the above	17.9	5.6	0.1
First semester at any college or university (%)	12.0	21.1	23.7
Total student count[d]	92,828	4,207	1,075

SOURCES: Hillsborough Community College calculations from enrollment data and MDRC calculations from Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences.

Missing values are only included in variable distributions for characteristics with more than 5 percent of the evaluation sample missing.

[a]Students who enrolled in multiple terms are counted more than once in the values shown.

[b]Students were counted as MAPS-eligible if they met the criteria described in Chapter 2. Data on age and Expected Family Contribution were not available for some students; these students were not counted as eligible. Students who enrolled in multiple terms are counted more than once in the values shown.

[c]Distributions may not add to 100 percent because categories are not mutually exclusive.

[d]Total student count for all HCC students and MAPS-eligible students includes some students more than once if they enrolled in multiple terms at HCC.

students to provide demographic and other background information. These data are used to describe the sample, to assess the similarity of the research groups, and to define subgroups of sample members for analyses.

- Field research: MDRC staff conducted three rounds of on-site field research that included interviews with staff, student focus groups, and Math Lab observations (spring 2011, fall 2011, and spring 2012). Staff who were interviewed included the MAPS program coordinator, program administrative assistant, MAPS payment processor, Math Lab directors, the dean of math, the academic support coordinator, and the vice president of academic affairs. The student focus groups were conducted with program and control group students separately. The attendance in these focus groups ranged from three to thirteen students. The team conducted Math Lab observations to better understand the program service environment. Five Math Lab observations were conducted at Brandon and six were conducted at Dale Mabry. Additionally, two tutor focus groups were conducted, one on each campus, during the last round of field research; the attendance in these focus groups ranged from seven to nine tutors.

- Financial aid data: HCC provided MDRC with annual data on the financial aid amounts awarded to and received by students for each academic year that the program operated.

- Integrated Postsecondary Education Data System (IPEDS) data: MDRC calculated the average cost per credit at HCC based on financial, enrollment, and instructional activity data reported to the U.S. Department of Education, National Center for Education Statistics, available online at IPEDS.[4]

- MAPS expenditure data: MDRC obtained cost information from program expenditure and scholarship receipt data as reported by HCC to the Helios Education Foundation from July 2010 to January 2013.

- Scholarship payment data: MDRC obtained data from HCC on scholarship payment records for all program group members for the program period. These data were used to describe rates of scholarship receipt.

- Student services utilization data: HCC used the *Who's Next* computerized tracking system to capture students' time spent in the Math Labs and other

[4]See http://nces.ed.gov/ipeds/datacenter.

student services centers. All students using the Math Lab centers were required to sign in and sign out. *Who's Next* data were analyzed for all service centers that offered tutoring, including the Math Labs, for the program period. (*Who's Next* is discussed in more detail in Chapter 3.)

- Student survey: MDRC administered a student survey to all three cohorts of sample members in spring 2012. The survey covered topics including sample members' educational experiences (including visits to Math Labs), use of MAPS scholarship funds, motivation, and other topics.

- Student transcript data: HCC provided MDRC with transcript data for sample members. These data comprise various course outcomes including courses registered for, withdrawn from, and passed; number of credits earned; and the grade received in each course. This report includes two years of follow-up for each cohort of the MAPS sample.

Chapter 3

Implementation, Student Participation, and Treatment Contrast

Chapter 1 described the core components of the Mathematics Access Performance Scholarship (MAPS) program model as it was designed. This chapter discusses how the program actually operated at Hillsborough Community College (HCC) — that is, how it was implemented in practice. In addition, this chapter explores how well the observed implementation of the program followed the intended design (sometimes referred to as "fidelity"),[1] and to what extent the experience of students in the program and control groups differed (sometimes referred to as "treatment contrast").[2]

Main Findings

The main findings are summarized below.

- **MAPS operated largely as designed.**

Program staff fulfilled their duties as expected, and scholarship payments and book bonuses were distributed with few errors.

- **More than 90 percent of students in the program group earned a MAPS award in the first semester, but rates of scholarship receipt declined to slightly less than 60 percent in the second semester and around 30 percent in the third semester.**

Rates of textbook receipt also dropped from around 36 percent in the first semester to 7 percent in the third semester. These rates decreased partly as a result of fewer students reenrolling each semester: only around 80 percent and 60 percent of program group students reenrolled in the second and third semesters, respectively. However, even after accounting for students who did not reenroll at HCC, rates of scholarship receipt declined: more than 95 percent of program group students who were enrolled in the first semester received a MAPS payment, while only slightly more than 50 percent of students who were enrolled in the third semester did.

[1]Mowbray, Holter, Teague, and Bybee (2003).
[2]Weiss, Bloom, and Brock (2014).

- **MAPS students were much more likely to visit the Brandon and Dale Mabry Math Labs than control group students.**

MAPS students were 38 percentage points more likely than control group students to visit the Math Labs in the first semester — 87 percent of program group students visited the Math Labs, compared with 49 percent of control group students. A similar difference occurred in the second semester. In both the first and second semesters, MAPS students also spent more time and made more visits to the Math Labs on average than control group students — more than doubling the average number of visits and average number of hours spent there by control group students.

Implementation of MAPS

This section discusses everything that went into making MAPS operational at HCC — that is, all the staffing and activities that took place that led to students being able to experience MAPS. These details may be important for other institutions interested in setting up and operating MAPS or a similar program.

Administrative Support

MAPS was created in part because administrators strongly supported a developmental math intervention. Staff and administrators reported a keen understanding of the developmental math challenge faced by many HCC students and a basic belief in the MAPS theory of change to improve math outcomes for most developmental math students. Administrators further demonstrated their support of the program by allocating additional resources to increase tutor staffing at the Math Labs. The Vice President of Academic Affairs noted,

> A lot of students simply have high levels of math anxiety… [and] lack foundational skills….The sheer volume of material that they have to cover in a single semester is a challenge…. [I hope that MAPS] will add to their motivation.

The support of administrators was key to the successful implementation of MAPS.

Key Staffing Roles and Duties

In addition to the administrators, many other HCC staff made significant contributions to MAPS. In order to support the program and study, the college designated staff members to manage and implement MAPS. The Vice President of Academic Affairs served as senior adviser to the project and assigned a full-time program coordinator to manage the day-to-day responsibilities of the program. The program was also supported by a number of staff across several departments and offices in the college, including financial aid, financial services, the office of institutional research (IR), and the Math Labs at Dale Mabry and Brandon.

Through most of the study, MAPS was staffed by one coordinator and supported by an administrative assistant. Their primary duties included recruiting students, planning and facilitating intake sessions, assisting students with registration for math courses, responding to program-related inquiries from students about scholarship payments and program requirements, making sure bonus textbooks and vouchers were distributed to students in a timely manner, and sending students program communications, such as e-mails notifying students of scholarship receipt and reminding students about program requirements.

Enrollment and Grade Verification

The process of verifying enrollment and grade data to determine which students earned the scholarship was conducted by staff from the office of institutional research. Throughout the program, a designated research analyst in the IR office kept track of which MAPS students remained enrolled in their developmental math classes beyond the add/drop period. These lists of students were then shared with staff in the financial aid office who issued the initial $100 scholarship payments.

At the end of each semester, a similar process was used to verify which students met the "C" or higher grade benchmark required to receive the final $500 scholarship. The IR analyst also noted which students met the "B" or higher grade benchmark and earned the bonus award. That information was shared with the program coordinator, who was responsible for purchasing and distributing the bonus awards to eligible students.[3]

Math Lab Visit Tracking

In addition to completing a math course with a "C" or better grade, MAPS students were required to visit the Brandon or Dale Mabry Math Labs a minimum number of times and spend a minimum number of hours at the labs each semester in order to earn the final $500 scholarship payments.[4] Tracking this component required cooperation among the program staff, the IR analyst, and the staff who managed the Math Labs.

The college used *Who's Next*, a software program for data content management and tracking, to determine the number of visits students were making and how much time they were spending in the Math Labs. This software required all students at both campuses to sign in when they entered the lab, choose their activities (including tutoring, computer use, and paper-and-pencil work), and sign out when they left the lab.

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[3]In some instances book vouchers that covered the cost of textbooks were distributed to students instead of actual textbooks.

[4]See Chapter 1 for more information about the MAPS program model and Math Lab requirements.

During the first semester, the sign-in and sign-out processes were not uniform across the Dale Mabry and Brandon campus Math Labs, and there were questions about the accuracy of the *Who's Next* data. A few students asked the program coordinator whether their hours were correct. The Math Lab managers, working with the program coordinator, found that there were some inaccuracies in the data; together, they reviewed and corrected the data. In subsequent semesters, Math Lab staff were trained to make sure students signed in and out uniformly, ensuring that students' logged visits and hours would be accurate.

Partly because of these issues, by the second semester the responsibility of reviewing the lab visit data was transferred to the IR analyst, who was given access to retrieve this information directly from the *Who's Next* database. This decision was also made to streamline the scholarship verification process. The analyst verified which students met the grade benchmark as well as the Math Lab visit requirements and sent that list to financial aid.

Other enhancements were made to the *Who's Next* tracking system over time. In particular, one addition to the software enabled students to view time spent in the lab over the course of a semester. When students signed in to the lab through the system, a text box appeared on the screen indicating how many hours they had spent in the lab since the start of the semester. While this appeared for all students using the lab, it enabled program group students to keep track of how close or far they were from meeting the Math Lab requirements. Additionally, this development decreased the number of student inquiries to Math Lab staff or the coordinator about their hours. In interviews with MDRC staff, students reported that they appreciated this update to *Who's Next*.

As a result of these changes, the tracking of service requirements improved over time. While most students who participated in focus groups during the spring 2011 semester agreed that the Math Lab tracking system was "susceptible to glitches," in fall 2011 most students reported that "the hours were accurate."

Financial Aid

One of the eligibility criteria for enrolling in the study was that students had to have an Expected Family Contribution (EFC) of 5,273 or below, the threshold for Pell Grant eligibility at that time. MDRC worked with HCC financial aid staff to ensure that the MAPS scholarship payments did not have a negative impact on students' financial aid packages, as the scholarship was intended to be awarded on top of existing aid. Financial aid officers were well acquainted with the fact that students' financial aid packages cannot exceed the total cost of attendance.[5] If

[5]A student's unmet financial need is calculated as the cost of attendance (including tuition, fees, books, and living expenses) minus the student's financial aid package minus the student's EFC.

students are offered aid above the total cost of attendance, then additional aid — in this case, the scholarship — cannot be added until another form of aid is replaced.[6] To ensure that students were aware of the potential impact on their aid packages, financial aid officers reviewed packages of all students who registered to attend a MAPS information session. Those students for whom adding the scholarship (if they were assigned to the program group) would require a replacement of aid were informed individually before they agreed to participate in the study.

Scholarship Payment Administration

Once the IR analyst determined which students met the Math Lab visit and grade requirements, the department sent the lists of students who achieved the benchmarks to the financial aid office. During the first semester of MAPS, a small number of incorrect payments were made to students.[7] By the second semester, the college designated someone from the college's financial services office, which deals with payment distribution, to take on the role of payment processor for the MAPS program in order to make the process more seamless. Having one person with a background in financial aid and financial services designated to handle the MAPS payments helped to prevent future errors. This payment processor received the lists of students who met the benchmarks from the IR analyst and ensured that the correct students received their scholarship payments.

HCC Math Lab Services

HCC's Dale Mabry and Brandon Math Labs are learning assistance centers that offer a variety of supports to students. During the study, the labs were staffed with tutors who were available to work with students in one-on-one appointments or in groups. Additionally, the labs were each equipped with approximately 40 computers that had the MyMathLab and Math XL software installed. Both MyMathLab and Math XL were created by the same textbook manufacturer. MyMathLab is designed to provide students with online practice, course materials, and video lectures, while Math XL is "an online homework, tutorial and assessment system."[8] The Math Labs also offer hard-copy worksheets for each developmental math course, corresponding

[6]Typically, the scholarship would replace aid in the form of a loan. If aid for a MAPS program student was repackaged and the student later decided to readjust the package and add the loan back, a change could be requested through the Financial Aid office at any point before the end of the semester.

[7]In the first semester, four erroneous payments were made to students who did not meet the scholarship criteria. Additionally, one student who met the final payment criteria did not receive the award. HCC was notified and followed up with the student. One additional erroneous payment was found in the second semester.

[8]See http://mxlmkt.pearsoncmg.com/product-overviews.

to specific chapters in students' textbooks. Definitions, concepts, examples, and problems for students to solve are provided on the worksheets.

The intention of the incentive to visit the Math Lab was to expose students to this academic support service, encouraging a base level of usage with the intention that students would see the value of this service and use the centers as needed, beyond the minimum required to earn the scholarship payment. MAPS did not dictate to students how to spend their time in the Math Lab, allowing them, rather, to determine for themselves the best way to use the labs' resources. All Math Lab services were available equally to control group students; they simply were not provided an incentive by MAPS to attend.

MDRC conducted 11 observations of student usage of the Math Labs, 5 at Brandon and 6 at Dale Mabry.[9] (Since the labs served all students, the activities of program or control students specifically may or may not have been observed.) Almost all students observed walking into the labs signed in at the front desk and selected their activities on a computer, which were recorded into the *Who's Next* database. Most students were observed signing out as well, which allowed the database to capture how much time each student spent at the Math Lab during each visit. During observations, students used each type of area designated for different types of math support activity, including areas with desktop computers set up individually for students to use Math XL and MyMathLab; areas in which students could sit next to their classmates to do group work or work with tutors in groups; and areas for students to work individually with tutors. Observations indicated a high level of engagement with all math activities in the labs.

Overall, most students observed in the Math Labs did independent, computer-based work. About 25 percent of students were observed interacting with tutors. Typically, six to seven tutors staffed the labs during the observations. Students were observed raising their hands to ask tutors to assist them with both computer and paper-and-pencil work. Students also worked with tutors individually and with groups of other students. Tutors served all students, not just MAPS students specifically.

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[9]Once Dale Mabry students complete Intermediate Algebra and begin college-level math, they must go to the "Learning Commons" if they want assistance from a tutor — they cannot continue to visit the Math Lab. MDRC conducted three observations of the Dale Mabry Learning Commons, which indicated that most students who visit sign in and go to the computers to work independently. Students seeking tutoring are required to make appointments in advance, typically by reviewing hard-copy schedules showing tutors' future availability. Appointments are in high demand; students may need to wait a few days before spaces are available. Most appointments appeared to last 30 minutes. Tutors do not "float" (that is, move from one student to another) in the Learning Commons as they do in the Math Labs.

Tutoring

During the program's operation, there were about 15 tutors assigned to work at the Brandon campus and 26 tutors assigned to work at the Dale Mabry campus Math Lab each semester. Most of the tutors at the Math Labs were either HCC students or students at nearby University of South Florida — that is to say, a peer tutoring model was predominantly used. The Math Lab at Dale Mabry, the larger campus, also employed a few instructors and adjunct faculty members as tutors.

Research on best practices in tutoring indicates that tutors should receive standardized training.[10] HCC chose the National Tutoring Association (NTA) to certify both the Dale Mabry and Brandon Math Lab tutoring programs and the individual tutors in each lab.[11] In order to qualify for certification through the NTA, staff had to receive 10 to 12 hours of training and professional development, divided into one- to two-hour modules made available over the semester. The content of the training includes both mathematics skills and how to tutor and work with students.

Before the study began, tutoring certification training was required at Brandon's Math Lab but not at Dale Mabry's. In order to better standardize the quality of tutoring services across campuses, the college decided to require Dale Mabry Math Lab tutors to complete the same certification training. In May 2011, Math Lab tutors at Dale Mabry and Brandon received training for tutoring certification using the NTA program. Certification training was provided by the Math Lab directors, who ensured that training time did not interfere with academic services provided for students. Training was built into regular staff meetings and tutors were compensated for time spent in training and meetings.

Two focus groups were held with tutors, one on each campus, during the final round of site visits. The tutors identified themselves as former HCC students, current students at the University of South Florida, and adjunct faculty. When asked about developmental math students' primary challenges, some tutors noted "lack of math vocabulary," or a basic deficiency in the fundamental mathematics concepts that make doing math and learning new math concepts easier. Tutors explained that these deficiencies usually lead to overdependence on tutors to walk students through their entire homework assignments. When discussing their own goals for students in the Math Labs, tutors expressed a desire for all students to internalize the lessons by working out the math problems on their own. These tutors emphasized that they usually help a student with one problem, then move on to the next student. The idea was not to

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[10]Rutschow and Schneider (2011).

[11]According to their website, "The NTA is now the oldest and largest association dedicated exclusively to tutoring." See www.ntatutor.com/about.html.

Box 3.1

How to Read the Impact Tables in This Report

Most tables in this report use the format illustrated in the abbreviated table below, which displays some survey data for the program and control groups that were part of the MAPS program at Hillsborough Community College. This shows that 94 percent of program group students visited the Math Lab, while 74.7 percent of control group students did so.

The "Difference" column in the table shows the difference in outcome between the two research groups — that is, the estimated average impact of the opportunity to participate in the program. For example, the estimated average impact on Math Lab visits can be calculated by subtracting 74.7 from 94.0, yielding an impact estimate of 19.4 percentage points. This difference represents the estimated average impact rather than the true average impact (which is impossible to determine) because, although study participants are randomly assigned to the program and control groups, the impact estimate would have been different if a different sample of students had been included in the study or if the same group of students had been randomized in a different way.

Differences marked with one asterisk or more are considered statistically significant, meaning that there is a high probability that the opportunity to participate in the program had an impact on that outcome measure. Differences that have no asterisks indicate that the opportunity to participate in the program did not have a discernible effect on that outcome. The number of asterisks indicates the probability that an impact at least as large as the one observed in the study would have occurred even if the true average impact had been zero. One asterisk corresponds to a 10 percent probability; two asterisks, a 5 percent probability; and three asterisks, a

(continued)

spend a lot of time with each student who sought help, which in turn fosters students' greater independence and confidence in their ability to solve math problems. Tutors reported that they most commonly helped students by "floating" in the labs — going from one student to the other and answering questions. During Math Lab observations, floating was the most common way tutors were seen interacting with students.

Tutors at both campuses also discussed collaborative tutoring — that is, getting students to work with one another on shared problems — as their preferred approach to tutoring. As one tutor described the lab, "It's very dynamic — sometimes there are three tutors and three groups of students working together!" Both Brandon and Dale Mabry tutors also spoke highly of the use of test corrections; in this scenario, instructors ask students to take the errors they made on exams to the Math Lab to correct them with tutor assistance.

Program Participation and Treatment Contrast

In order for MAPS to have academic impacts, the program needed to create a treatment contrast — that is, program group students needed to have different experiences from their

Box 3.1 (continued)

1 percent probability. The more asterisks, the more likely the opportunity to participate in the program had a true average impact on the outcome. The impact in the table excerpt below has three asterisks, indicating that the impact is statistically significant at the 1 percent level — meaning that there is only a 1 percent chance of observing an estimated average impact this large (or larger) if the opportunity to participate in the program actually had *no* average effect on credits earned. In other words, there is a 99 percent level of confidence that the opportunity to participate in the program had a positive impact on the average number of credits earned.

Also shown in the table is the standard error of the impact estimate. The standard error is a measure of uncertainty or variability around the impact estimate. Some useful rules of thumb are that there is about a 90 percent chance that the true average impact is within plus or minus 1.65 standard errors of the estimated average impact, roughly a 95 percent chance that the true average impact is within plus or minus 1.96 standard errors of the estimated average impact, and about a 99 percent chance that the true average impact is within plus or minus 2.58 standard errors of the estimated average impact.

The survey tables included in this report list sample size for each individual measure, as students who responded to the survey may not have answered every question. The impact tables show sample size in the last row, as the sample size for all measures is the same.

Outcome	Sample Size	Program Group	Control Group	Difference	Standard Error
Ever visited an HCC Math Lab (%)	846	94.0	74.7	19.4 ***	2.3

control group counterparts. This section examines students' program participation and the treatment contrast that ensued, including scholarship receipt, financial aid receipt, and the use of Math Lab services. Additionally, the section presents some survey results on differences in educational experiences, employment, and motivation. Box 3.1 provides information on how to read the impact tables in this and subsequent chapters. For more information about the survey, including information about the students who responded to the survey, see Appendix B.

Time Periods Used in This Chapter

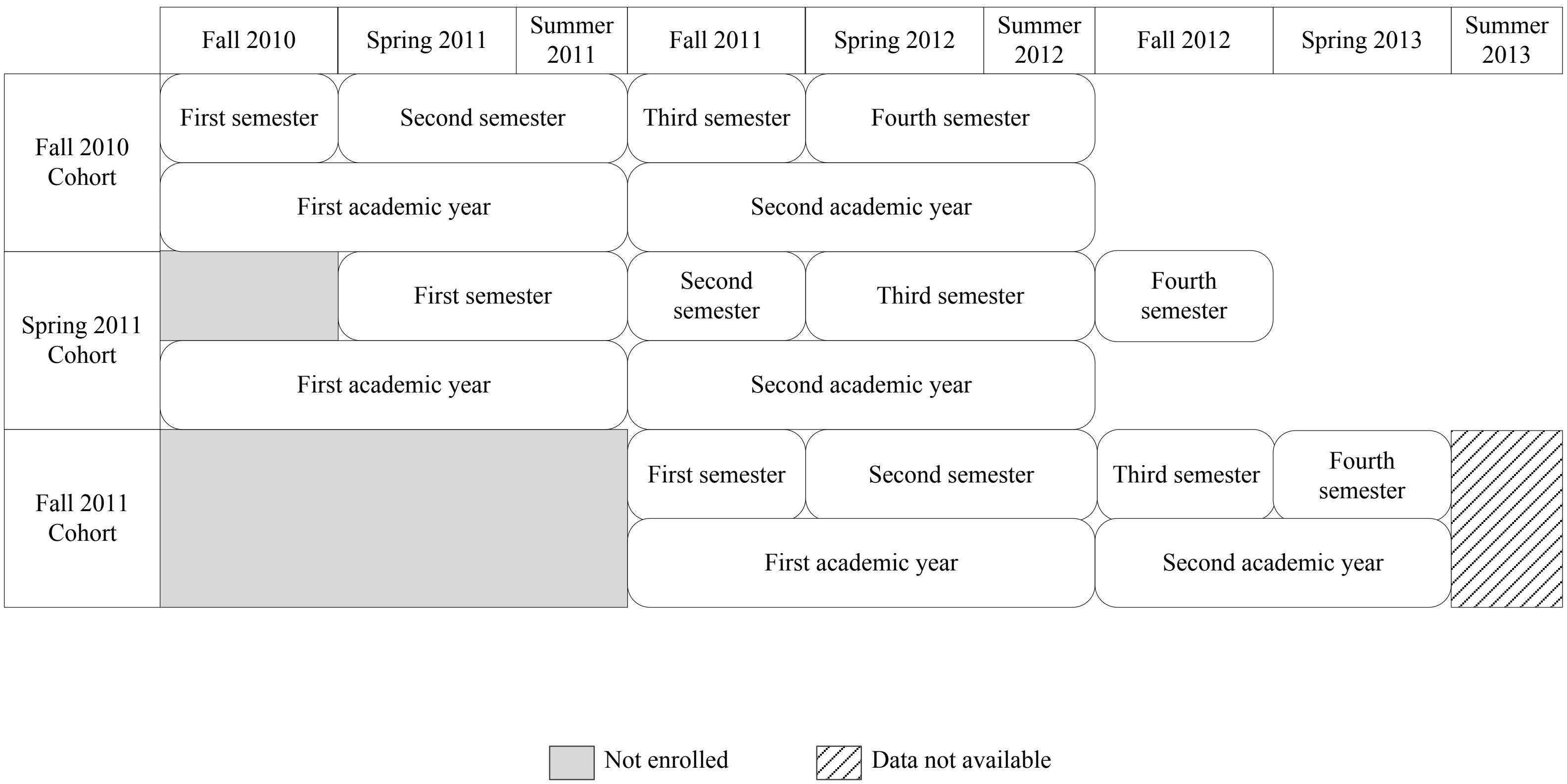
The tables and figures presented in this chapter group HCC's fall, spring, and summer semesters together in one of two ways, both of which are illustrated in Figure 3.1. Most of the tables and figures are organized into "first semester" through "fourth semester." Here, the "first semester" refers to the semester in which students were randomly assigned into the study; the "second semester" refers to the next semester, and so on. For the fall 2010 cohort, for example, the "first semester" is the fall 2010 semester. In order to more effectively make comparisons between fall and spring cohorts, spring and summer semesters are combined in

The Performance-Based Scholarship Demonstration

Figure 3.1

Time Periods Used in Chapter 3

Hillsborough Community College



this organizational scheme. For the spring 2011 cohort, therefore, the "first semester" includes both the spring 2011 and summer 2011 semesters.[12] Figure 3.1 shows how these periods were constructed for each cohort.[13]

For financial aid data, only annual values were available. Financial aid results are therefore presented in periods of first academic year and second academic year. Each academic year consists of a sequential set of fall, spring, and summer semesters.[14] The "first academic year" is the academic year in which students were randomly assigned into the study. Figure 3.1 summarizes these time periods for each cohort.

Scholarship Receipt

As shown in Table 3.1, rates of scholarship receipt were initially high: in the first semester, more than 92 percent of program group students received an initial payment for enrolling in a course in the MAPS sequence. Nearly 54 percent of the program group met the relevant Math Lab requirements and passed their course, receiving a final payment, while 36 percent of program students earned a grade of "A" or "B" and received a textbook in the following semester.

The rate of scholarship receipt fell in the second semester: only 58 percent of program students received a MAPS payment, with 53 percent receiving an initial payment for enrolling in a course in the MAPS sequence and less than 37 percent receiving a final payment for passing a MAPS course and meeting associated Math Lab requirements.[15] A smaller proportion of the program group, 16.5 percent, received a textbook in the third semester for earning a grade of "A" or "B" in the second semester. However, fewer than 80 percent of study students registered at HCC in the second semester, so a substantial portion of the drop in scholarship receipt was driven by students who did not enroll at HCC at all.

[12]Rates of enrollment in summer semesters were low compared with enrollment rates in the spring and fall semesters. As a result, combining values for spring and summer semesters into a single semester (for example, "first semester") yields values that are generally similar to the spring semester alone.

[13]Different time periods are used in the analyses presented in Chapters 3 and 4. In Chapter 3, spring and summer semesters are always combined when counting semesters following random assignment. In Chapter 4, spring and summer semesters are treated separately for the spring 2011 cohort in order to calculate more comparable estimates of program effects across all cohorts. Figures 3.1 and 4.1 illustrate the differences between the time periods used in the two chapters.

[14]Data for summer 2013 were not available as of the writing of this report.

[15]In the second and third semesters, some students received either only an initial payment or a final payment, but not both. As a result, the proportion of students who received any payment in those semesters was higher than the proportion who received either type of payment individually.

The Performance-Based Scholarship Demonstration

Table 3.1

Scholarship Receipt Among Program Group Members

Hillsborough Community College

Outcome	Program Group
First semester	
Registered for any course (%)	95.7
Received one or more scholarship payments (%)	92.6
Received initial payment	92.6
Received final payment	53.9
Received a textbook[a]	36.1
Average scholarship amount [b] ($)	398
Average scholarship amount among recipients [b]	*430*
Second semester	
Registered for any course (%)	79.5
Received one or more scholarship payments (%)	58.2
Received initial payment	52.7
Received final payment	36.8
Received a textbook[a]	16.5
Average scholarship amount [b] ($)	272.7
Average scholarship amount among recipients [b]	*473.7*
Third semester	
Registered for any course (%)	59.8
Received one or more scholarship payments (%)	30.3
Received initial payment	25.7
Received final payment	18.7
Received a textbook[a]	7.0
Average scholarship amount [b] ($)	119.1
Average scholarship amount among recipients [b]	*393.6*
Sample size	674

SOURCES: MDRC calculations from Hillsborough Community College scholarship payment data and transcript data.

NOTES: Characteristics shown in italics are calculated for a subset of the program group.

Semesters consist of either a fall semester only or a spring and summer semester combined. As a result, some students may earn up to two initial or final scholarship payments in a single program semester (once in spring, and again in summer). These students are counted only once when calculating the percentage of students who received payments. However, their scholarship amount reflects all payments that they received in the spring and summer semesters.

[a]Values shown above reflect only the students who redeemed their vouchers the following semester, not all students who were given a voucher; the latter value is not available.

[b]Scholarship amount includes initial and final awards and excludes textbook price.

Rates of scholarship receipt declined again in the third semester. Slightly more than 30 percent of program group students received a MAPS payment of any type. Almost 26 percent of the program group received an initial payment for registering for a course in the MAPS sequence, and nearly 19 percent received a final payment for passing the class and meeting relevant Math Lab requirements. Only 7 percent of program group students received a textbook in the fourth semester for earning a grade of "A" or "B" in their MAPS course in the third semester. As in the second semester, the decreasing rate of scholarship receipt was driven in part by program group students who did not enroll at HCC: less than 60 percent of students enrolled at HCC in the third semester.

The declining portion of students enrolled at HCC in each successive semester was an important factor in the drop in scholarship receipt. Figure 3.2 illustrates that this decline in enrollment was comparable for both program and control group students. While more than 90 percent of students enrolled in the first semester, fewer than 80 percent of either the program or control group enrolled in the second semester. This downward pattern continued in the third and fourth semesters, with only approximately 60 percent and 50 percent of both groups enrolling in each semester, respectively. However, even after accounting for students who did not reenroll at HCC, rates of scholarship receipt declined: more than 95 percent of program group students who were enrolled in the first semester received a MAPS payment, while only slightly more than 50 percent of students who were enrolled in the third semester did. Lower rates of scholarship receipt in the second and third semesters may therefore also have been driven by lower rates of success among program group students who were still enrolled at HCC, as these students either failed courses in the MAPS sequence or chose not to enroll in these courses at all.

Student Opinions and Use of Scholarship Dollars

Program group students were surveyed regarding their opinions of and primary use of the MAPS scholarship.[16] As shown in Table 3.2, more than 80 percent of program group students who could recall participating in the program considered the scholarship either "useful" or "very useful" for academic success, and more than 75 percent of the students considered it either "important" or "very important" financially for staying in school.[17] Furthermore, many

[16]The student survey covered a variety of topics, including students' educational experiences, experiences with the Math Labs, experiences with the MAPS program, self-confidence, motivation, work experiences, financial situation, and psychological well-being. The survey response rate was 79 percent. Two analyses for potential biases in survey responses were conducted; the analyses found that students who responded to the survey may differ from those who did not with regard to certain baseline characteristics. See Appendix B for further discussion.

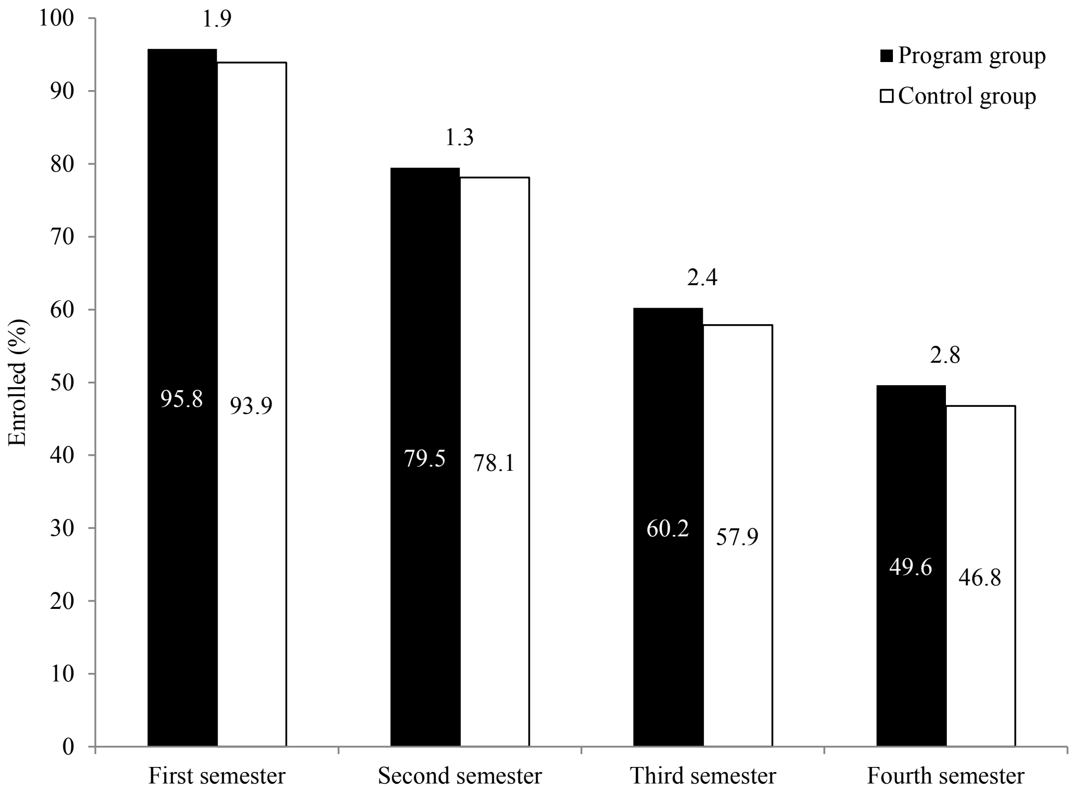
[17]Although students considered the scholarship important for their ability to stay in school financially, the scholarship program did not have an impact on students' persistence — see Chapter 4.

The Performance-Based Scholarship Demonstration

Figure 3.2

Student Enrollment During the First Through Fourth Semesters

Hillsborough Community College



SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

students in focus groups stated that the quality of their math instruction, more so than either MAPS scholarship dollars or tutoring, had the greatest influence on their success in math. These findings serve as reminders that while many students found the scholarship dollars useful, other factors also played substantial roles in students' persistence and academic success.

More than 90 percent of program group students who could recall receiving a MAPS payment reported that they used the MAPS awards primarily either to pay for school (42.5

The Performance-Based Scholarship Demonstration

Table 3.2

Student Opinions and Use of Scholarship Dollars Among Program Group Members

Hillsborough Community College

Outcome (%)	Sample Size	Program Group
Recall being a participant in MAPS	549	99.3
Of those who recall being a participant in MAPS		
Recall receiving e-mails from MAPS	*544*	*98.7*
Knew minimum grade needed for performance payment	*544*	*86.8*
Remember receiving payment from MAPS	*530*	*88.5*
MAPS useful/very useful to academic success	*545*	*80.2*
MAPS important/very important for staying in school financially	*544*	*75.9*
Of those who recall receiving a MAPS payment		
Main use of scholarship		
To pay for school (tuition, fees, books, etc.)	*468*	*42.5*
To help with basic living expenses (bills, food, housing, etc.)	*468*	*47.9*
To help with child care costs	*468*	*1.9*
To buy clothes or shoes	*468*	*0.2*
To deposit into bank account	*468*	*3.4*
To buy something normally could not afford or entertainment	*468*	*1.7*
To work fewer hours at job	*468*	*1.3*
Some other way	*468*	*0.2*
Don't remember	*468*	*0.9*
Sample size	549	

SOURCE: MDRC calculations using responses from the Performance-Based Scholarship Hillsborough Community College survey.

NOTES: Characteristics shown in italics are calculated for a subset of the program group.
Missing values are not included in individual variable distributions.

percent) or to help with basic living expenses such as bills, food, and housing (47.9 percent.) Far fewer program group students reported using the award primarily for other things, such as child-care costs, clothes, or savings.

Financial Assistance

As described previously, the MAPS scholarship was intended to be awarded on top of all other financial aid and not to displace other forms of aid. An analysis of financial aid data, shown in Table 3.3, illustrates that the program functioned as intended, and that there was a difference for program and control group students: in their first academic year of MAPS, the number of program group students receiving aid was 3.6 percentage points greater than the

The Performance-Based Scholarship Demonstration

Table 3.3

Impacts on Annual Financial Assistance During the First Two Academic Years

Hillsborough Community College

Outcome	Program Group	Control Group	Difference	Standard Error
First academic year				
Received any financial assistance (%)	97.8	94.2	3.6 ***	1.2
Received Pell Grant	92.9	93.0	-0.1	1.6
Received MAPS award[a]	95.0	0.2	94.7 ***	1.1
Received other grants[b]	26.5	25.0	1.5	2.8
Received subsidized loans	29.9	29.4	0.5	2.9
Received unsubsidized loans	22.1	19.5	2.6	2.6
Received private loans	0.0	0.4	-0.4	0.3
Received work-study	2.2	1.0	1.3	0.8
Average annual financial assistance received ($)	7,378	6,214	1,163 ***	261.7
Pell Grant	4,131	4,029	103	119.0
MAPS award[a]	767	2	765 ***	27.6
Other grants[b]	455	353	101 *	60.2
Subsidized loans	1,024	1,013	11	101.3
Unsubsidized loans	916	764	152	117.4
Private loans	2	19	-17	11.9
Work-study	82	34	48	35.8
Percentage of financial assistance received by recipients (%)				
As grants/scholarships	*82.9*	*81.8*		
As loans	*16.5*	*18.0*		
As work-study	*0.6*	*0.2*		
Second academic year				
Received any financial assistance (%)	64.6	61.0	3.7	3.1
Received Pell Grant	58.4	57.5	0.9	3.1
Received MAPS award[a]	38.2	0.0	38.2 ***	2.4
Received other grants[b]	22.7	21.9	0.8	2.6
Received subsidized loans	37.2	37.1	0.1	2.9
Received unsubsidized loans	32.9	32.4	0.5	2.7
Received private loans	0.0	0.0	0.0	0.0
Received work-study	2.2	1.1	1.1	0.8
Average annual financial assistance received ($)	5,602	5,035	568 *	344.5
Pell Grant	2,144	2,086	58	137.7
MAPS award[a]	195	0	195 ***	15.9
Other grants[b]	346	287	59	48.3
Subsidized loans	1,397	1,347	51	110.5
Unsubsidized loans	1,429	1,300	129	129.2
Private loans	0	0	0	0.0
Work-study	92	19	73 **	34.3

(continued)

Table 3.3 (continued)

Outcome	Program Group	Control Group	Difference	Standard Error
Percentage of financial assistance received by recipients (%)				
As grants/scholarships	*61.1*	*59.0*		
As loans	*37.8*	*40.7*		
As work-study	*1.2*	*0.3*		
Sample size (total = 1,075)	674	401		

SOURCE: MDRC calculations from Hillsborough Community College financial aid data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between the research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent.

Outcomes shown in italics are nonexperimental. Statistical significance tests are not conducted on nonexperimental outcomes.

The academic year is defined as fall through summer.

For the fall 2010 and fall 2011 cohorts, students were eligible to earn MAPS awards in all three semesters included in the first academic year. For the spring 2011 cohort, students were only eligible to earn MAPS awards during the spring and summer semesters of the first year. The second year of data includes one fall semester in which students in the fall 2010 and fall 2011 cohorts could earn MAPS awards, and two semesters (fall and spring) in which students in the spring 2011 cohort could earn MAPS awards.

[a]In general, only program group students received MAPS awards. One control group student received a MAPS award erroneously.

[b]This includes all grants and scholarships except for Pell Grants and MAPS awards.

number of control group students who received aid. This result was surprising, as the program was designed to increase the amount of aid that students receive, but not necessarily to extend aid to a greater proportion of students. Program group students also received an average of $1,163 more in aid than did control group students.[18] These differences in average aid received were mainly due to MAPS awards: program group members received an average of $767 in MAPS awards, while control group members received close to $0.[19] The difference in average total amount of aid received suggests that the program was working as intended, and that MAPS awards were truly being treated as “last dollar” awards.

[18]These values reflect the average aid amounts for all cohorts during their first academic year of MAPS, beginning with the fall semester and ending with the following summer semester. Data were not available for individual semesters broken out separately. Because the data were only available for each academic year, the first academic year includes one fewer semester of MAPS aid for students who enrolled in the program beginning in a spring semester, while the second academic year includes fewer semesters of MAPS aid for students who enrolled in the program beginning in a fall semester.

[19]One control group member was accidentally awarded a MAPS scholarship.

Similar differences were also found for the second academic year of the program, although they were smaller. In the second academic year, as in the first, there is no evidence that the MAPS scholarship displaced other awards from students' financial aid packages.

Math Lab Use

As noted in Chapter 1, HCC faculty and administrators were concerned that students were underutilizing Math Lab services and thought that increased use of the Math Labs would help drive better academic outcomes. MAPS was therefore designed to encourage greater student use of the Brandon and Dale Mabry Math Labs. A review of *Who's Next* tracking data for the labs confirms that program group students made greater use of the labs than did control group students. Table 3.4 shows the levels of use of the Math Labs by program and control group students and the differences between the two groups. Throughout this period, program group members consistently used the Brandon and Dale Mabry Math Labs at higher levels than did control group students. Program group members were more likely to visit the Math Labs, had a higher average number of visits, and spent more time there on average. The program also appeared to significantly increase the proportion of students who used Math Lab services heavily (5 hours or more per semester or 10 hours or more per semester). For example, in the first semester, 35.6 percent of program group students spent 10 hours or more at the Math Labs, compared with only 15.0 percent of control group students.[20]

In focus groups, program group students generally had positive things to say about the Math Labs and the tutors. They reported that the workshops and end-of-semester reviews were helpful, and that most tutors were knowledgeable. As one student said, "With the Math Lab, there [are] tutors and floaters, and you [can] get your question answered in a maximum of 10 to 15 minutes. Then you [can] understand it, do more, and when you have another question, someone [is] there." One student who had finished her developmental math courses and moved on to college-level math said, "For this class, I am not required to take any tutoring for MAPS, but I'm still there [at the Math Lab] every day to do homework or ask questions." Some students also said that studying in the lab helped them stay motivated and on task. Although several students reported that the Math Labs can get noisy, students agreed that the lab was a good place to do work without too many distractions, and that visiting the Math Lab was easy to fit into their schedules before or after class, since tutoring appointments were not required. One student made one-hour appointments with various tutors and said, "They would definitely come help me if I had a problem." She reported spending about 70 hours in the Math Lab each semester, far

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[20]Students enrolled in Beginning Algebra were required to spend five hours in the Math Lab in order to receive their final $500 MAPS payment. Later MAPS courses had lower Math Lab requirements.

The Performance-Based Scholarship Demonstration

Table 3.4

Learning Assistance Center Use

Hillsborough Community College

Outcome	Program Group	Control Group	Difference		Standard Error
First semester					
Registered for any course (%)	95.8	93.9	1.9		1.4
Used any learning assistance center (%)	88.5	60.4	28.1	***	2.5
Brandon or Dale Mabry Math Labs	86.8	48.9	37.9	***	2.6
Other learning assistance centers	31.1	28.5	2.7		2.9
Number of visits to any learning assistance center	11.5	4.9	6.6	***	0.8
Brandon and Dale Mabry Math Labs	9.7	3.5	6.1	***	0.6
Other learning assistance centers	1.9	1.4	0.5		0.4
Hours spent at any learning assistance center	14.5	5.7	8.8	***	1.5
Brandon or Dale Mabry Math Labs	12.4	4.5	7.9	***	1.2
Other learning assistance centers	2.1	1.2	0.9		0.6
Hours spent at Brandon or Dale Mabry Math Labs (%)					
5 hours or more	69.6	22.9	46.7	***	2.9
10 hours or more	35.6	15.0	20.6	***	2.8
Second semester					
Registered for any course (%)	79.5	78.1	1.3		2.6
Used any learning assistance center (%)	62.2	36.6	25.6	***	3.1
Brandon or Dale Mabry Math Labs	56.0	23.2	32.8	***	3.0
Other learning assistance centers	24.1	21.7	2.4		2.7
Number of visits to any learning assistance center	5.8	2.8	3.0	***	0.6
Brandon and Dale Mabry Math Labs	4.4	1.6	2.8	***	0.4
Other learning assistance centers	1.5	1.2	0.3		0.3
Hours spent at any learning assistance center	6.9	3.1	3.8	***	0.8
Brandon or Dale Mabry Math Labs	5.4	2.0	3.4	***	0.6
Other learning assistance centers	1.5	1.1	0.4		0.4
Hours spent at Brandon or Dale Mabry Math Labs (%)					
5 hours or more	29.2	10.3	18.9	***	2.6
10 hours or more	15.6	6.4	9.2	***	2.1

(continued)

more than the hours required for MAPS. While some focus group students said that they knew about the Math Lab before joining MAPS, one student credited MAPS with her math success:

> I'll be honest, I probably wouldn't have known about the Math Lab if not for MAPS. I probably would have taken the courses online instead. Before this program, I took like three years off, and I tried an online course and I was on my own without the Math Lab.

Table 3.4 (continued)

Outcome	Program Group	Control Group	Difference	Standard Error
Third semester				
Registered for any course (%)	60.2	57.9	2.4	3.1
Used any learning assistance center (%)	31.7	23.5	8.2 ***	2.9
Brandon or Dale Mabry Math Labs	22.2	11.3	10.9 ***	2.4
Other learning assistance centers	16.5	16.9	-0.4	2.4
Number of visits to any learning assistance center	2.8	1.6	1.1 **	0.5
Brandon and Dale Mabry Math Labs	1.6	0.6	1.0 ***	0.3
Other learning assistance centers	1.2	1.0	0.2	0.3
Hours spent at any learning assistance center	3.9	2.0	1.9 **	0.8
Brandon or Dale Mabry Math Labs	2.4	1.0	1.4 **	0.7
Other learning assistance centers	1.5	1.0	0.4	0.5
Hours spent at Brandon or Dale Mabry Math Labs (%)				
5 hours or more	10.1	4.2	5.9 ***	1.7
10 hours or more	5.9	2.1	3.7 ***	1.3
Sample size (total = 1,075)	674	401		

SOURCE: MDRC calculations from Hillsborough Community College *Who's Next* data on tutoring service use.

NOTES: Rounding may cause slight differences in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

The tutoring requirements for the MAPS scholarship are a minimum of 5 hours and 5 visits to the Math Lab for those enrolled in Beginning Algebra and a minimum of 3 hours and 3 visits to the Math Lab for those enrolled in Intermediate Algebra. There is no tutoring requirement for those enrolled in college-level math courses.

Learning assistance centers used in this analysis include the Brandon and Dale Mabry Math Labs and other centers across all campuses that offered tutoring services.

Semesters consist of either a fall semester only, or spring and summer semester combined.

Program and control group members' rates of utilization were also compared at other learning assistance centers that offered tutoring services, including centers on other campuses, to determine whether the MAPS scholarship was causing students to use these centers less in order to spend more time at the Brandon and Dale Mabry Math Labs. Analysis of *Who's Next* data showed that both program and control groups used other student services centers at comparable rates. Both groups of students had comparable average numbers of visits to the other centers and spent comparable amounts of time at them. This suggests that the additional time spent at the MAPS Math Labs did not cause students to spend less time at other tutoring locations.

Educational Experiences and Other Mediators

In addition to analyzing HCC *Who's Next* records to estimate the contrast in services received, MDRC surveyed both program and control group students regarding a variety of topics in order to analyze whether the program changed students' experience at HCC in other ways. The survey included academic topics such as students' study habits, their experience at the Math Labs, and their use of tutors, as well as nonacademic topics such as students' employment and reasons for wanting to do well in school. All three cohorts of students were surveyed in the spring 2012 semester, meaning that different cohorts were at different points in the math sequence when they were surveyed.[21] Survey results showed that the program had substantial impacts on students' experiences in some areas, but no impact in others.

Educational Experiences

Table 3.5 displays selected results from the survey. As a complement to the analysis of *Who's Next* records, students were surveyed about their study habits and their use of student services available at HCC.[22] Students in both the program and control groups indicated that they had spent an average of approximately nine hours studying for their last paper, exam, or project. However, students in the two groups differed in where they had sought assistance: program group students were 7.5 percentage points more likely than their control group counterparts to have asked a tutor for help (20 percent of program group students versus 13 percent of control group students). This suggests that the program changed the rate at which students made use of certain academic support services. Test anxiety was mentioned as an issue during student focus groups; program group students may have been using tutors as a means to address this issue. Despite being more likely to seek assistance from tutors, program group students felt as prepared as control group students for their most recent final paper, exam or project, with 60 to 65 percent of both groups indicating that they felt "quite a bit" or "extremely well" prepared. It is unknown whether the program group students' increased use of tutors as a source of assistance translated into an improved result on their papers, exams, or projects.

As expected from the analysis of *Who's Next* data, program group students reported that they were much more likely to have visited the Math Labs than control group students: 94 percent of program group students reported ever having visited the Math Labs, compared

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[21]For example, as of the spring 2012 semester, the fall 2010 cohort had completed the program, while the fall 2011 cohort continued to receive the scholarship. Results discussed in this section were analyzed for each cohort separately, in addition to being analyzed for all cohorts together. Results for each cohort individually were generally similar.

[22]The survey questions discussed in this paragraph were not specific to math; the survey asked students about their overall study habits, use of resources, and academic preparedness across all subject areas together.

The Performance-Based Scholarship Demonstration

Table 3.5

Student Educational Experiences

Hillsborough Community College

Outcome	Sample Size	Program Group	Control Group	Difference		Standard Error
Currently attending or was ever enrolled in postsecondary institution beyond high school, after random assignment (%)	847	96.1	94.4	1.8		1.5
Total hours spent on most recent final paper/exam/project	842	8.6	8.8	-0.2		1.0
Sought help on most recent final paper/exam/project from[a] (%)						
Tutor	842	20.0	12.5	7.5	***	2.7
Instructor	842	22.9	22.0	0.9		3.1
Other students in the class	842	26.1	25.5	0.7		3.2
People not in the class	842	17.6	17.6	0.0		2.8
No one	842	39.7	44.4	-4.7		3.6
Felt quite a bit or extremely well prepared for most recent final paper/exam/project (%)	845	65.1	62.4	2.7		3.5
Hours spent studying for math per day (last 7 days)	844	1.5	1.4	0.0		0.2
Ever visited an HCC Math Lab (%)	846	94.0	74.7	19.4	***	2.3
Usual activity in the Math Lab[a] (%)						
Participate in one-on-one tutoring	845	49.9	39.2	10.7	***	3.6
Participate in group help session	845	17.5	13.4	4.1		2.7
Use online math help resources	845	76.4	52.9	23.5	***	3.3
Something else	845	8.7	10.2	-1.5		2.1
No usual activity or never visited Math Lab	845	6.4	26.0	-19.7	***	2.4
Of those who participated in one-on-one tutoring (%)						
Found it helpful or very helpful	*384*	*89.8*	*86.4*			
Of those who participated in group session (%)						
Found it helpful or very helpful	*135*	*89.5*	*80.0*			
Of those who participated in online help (%)						
Found it helpful or very helpful	*569*	*89.1*	*87.2*			
Sample size	847	549	298			

SOURCE: MDRC calculations using responses from the Performance-Based Scholarship Hillsborough Community College survey.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Outcomes shown in italics are nonexperimental. Statistical significance tests are not conducted on nonexperimental outcomes.

Missing values are not included in individual variable distributions.

[a]Distributions may not add to 100 percent because categories are not mutually exclusive.

with roughly 75 percent of control group students.[23] Program group students were also more likely than control group students to have participated in one-on-one tutoring and were more likely to have used online math help. Among both program and control group students who used various Math Lab services, more than 80 percent found each of the services to be helpful.

Employment

Students were also surveyed about their level of employment. One hypothesized effect of performance-based scholarships was that they would allow students to reduce the number of hours they were working during the semester and focus more of their attention on academics instead. This does not appear to have happened — the proportion of students who reported they were working as of the time of the survey, the number of hours they were working, and the proportion of students who reported being “financially stressed” was unchanged between the program and control groups. (See Appendix Table B.3.) This suggests that the amount of the scholarship being offered and the frequency with which program group students received the award were not great enough to change the employment situation of program group students on average.

Motivation

Last, students were surveyed about their motivation to do academic work. As with any incentive program, there was some concern that offering students awards in exchange for academic performance would cause them to become more “extrinsically” motivated (that is, motivated by the promise of scholarship money, rather than by intellectual interest or other reasons). Student survey results suggest that this did not occur: students in both the program and control groups reported a comparable mix of intrinsic and extrinsic motivation. (See Appendix Table B.3.)

As noted above, MAPS was designed to increase students’ motivation to enroll in and complete their math courses and continue to enroll in the next course in the sequence. In focus groups, program group students reported that they came into their developmental math courses motivated to succeed; however, many noted that the program did “push” them to work a bit harder to make sure they met the academic benchmark, which none felt was particularly high. Many students expressed that they were already motivated to earn the “C” grade required to pass the course and move up to the next course. In a program student focus

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[23]This is somewhat higher than the proportion of the control group that was recorded in *Who’s Next* data as having visited the Brandon and Dale Mabry Math Labs. (See Table 3.4.) The difference may be due to a variety of factors, including inaccurate recollections by students, problems with the *Who’s Next* system, or differences in the subset of the control group who responded to the survey.

group, the general reaction to the scholarship offer was, "Why not get paid for doing something that you have to do anyway?"

Overall, MAPS students in focus groups described the textbook bonus for earning an "A" or "B" grade as a better motivator to improve their grade in math compared with the scholarship for earning a "C." These students expressed frustration with the rising prices of college textbooks, a common theme for low- and moderate-income students.[24] Students reported that their math textbooks usually cost more than $100. Many MAPS students said they thought about the bonus benchmark every day in class. As one student put it, "The MAPS program is making me do wonders….I would have settled for a C, but I'm fighting for an A."

When asked what they thought about the opportunity to earn a MAPS award, control group students were split between those who felt that they would have focused and tried harder in their math classes had they been selected for the program and those who did not think that the scholarship would have changed their behavior.

Summary

This chapter described how MAPS was implemented, including the roles of college staff and differences in experiences between students in the program and control groups. Overall, the program was implemented well, with a high level of fidelity to the model. Student scholarship payments were disbursed accurately with few errors, and program group students experienced MAPS as a notable difference from regular college services. The next chapter looks at the impact of MAPS on students' academic outcomes.

[24]The Advisory Committee on Student Financial Assistance (2007).

Chapter 4

Program Effects on Academic Outcomes

This chapter of the report presents findings on the Mathematics Access Performance Scholarship (MAPS) program's effects on students' academic progress at Hillsborough Community College (HCC) during the first two years after they entered the study. The results represent the estimated effect of the opportunity to participate in MAPS on (1) students' academic progress in math (both developmental and college-level) and (2) students' overall academic progress in school.

The program's effects, or impacts, are estimated by comparing the outcomes of all students who were randomly assigned to the program group with the outcomes of all students who were randomly assigned to the control group.[1] Random assignment results in two groups of students who are similar at the outset of the study, both with respect to their observable characteristics (for example, gender, age, and race) as well as unobservable characteristics (for example, tenacity and motivation). As a result, subsequent substantial differences in outcomes between the two groups can be attributed with confidence to the opportunity to participate in MAPS, rather than to preexisting systematic differences between the two groups.

Main Findings

After two years, students who were offered the opportunity to participate in MAPS performed better, particularly in mathematics, than they would have in the absence of the program. Specifically:

- **MAPS helped move students further along in the math course sequence.**

Compared with their control group counterparts, MAPS students were 11 percentage points more likely at the end of two years to complete a college-level math course or Intermediate Algebra as their highest-level math course. In terms of math credits, this translates to an estimated average effect of 0.7 math credit, or a 15 percent increase in math credit accumulation.

- **There is evidence that MAPS improved students' *overall* academic progress as measured by total credit accumulation. This occurred, in part, because students made greater progress in mathematics.**

[1]Students who were not enrolled at HCC during the follow-up period are treated as nonenrollees who earned zero credits.

The program's positive effect on progress in math did not come at the expense of other coursework. There is no evidence that MAPS had a *negative* effect on students' progress in their non-math courses. The program's estimated effect on total credit accumulation, including both math and non-math credits, is statistically significant after one semester, one year, and one year and one semester. After two years, students who were offered MAPS earned 1.6 more total credits, a 7 percent increase, than their control group counterparts, although this difference is not statistically significant. Taken together, this evidence suggests that MAPS improved students' overall academic progress.

- **The program had no discernible impact on students' retention.**

Over the first four semesters, MAPS had no statistically significant impact on students' enrollment rates. That is, program group students were not significantly more likely to reenroll in subsequent semesters than control group students.

- **Analyses suggest that MAPS may be more effective for financially independent students and for students who entered the study more than a year after graduating from high school or receiving a General Educational Development (GED) certificate.**

There is evidence that suggests that MAPS was more effective for financially independent students.[2] It is hypothesized that since these students are responsible for their own financial situation, a monetary incentive is more salient and provides a greater motivation to them. This finding will be strengthened if it can be replicated at other colleges that are implementing performance-based scholarships. MAPS also appears to have been more effective for students who entered the study a year or more after graduating from high school or earning a GED certificate. This subgroup is intended as a proxy for students who have been out of the math classroom for a while. HCC staff members hypothesized that MAPS might be most effective for such students because they may have experienced learning loss; thus, encouragement to take math and an incentive to use support services could prove particularly beneficial to these students. Results provide support for this theory. Notably, though, the subgroup based on financial independence and the subgroup based on delayed college enrollment have significant overlap, so these findings may not be independent.

The above results are described in detail below.

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[2]Students were defined as financially independent if they met any of the following criteria as of their random assignment into the study: they were age 24 years or older, they were married, or they had one child or more. This imperfect proxy for financial independence is an adaptation of the definition used for the Free Application for Federal Student Aid (FAFSA), based on the data available to the research team.

Description of Key Outcomes

Before delving into the findings, it is important to understand the outcome measures that were used to assess the program's effectiveness. The analyses of the academic effects of MAPS emphasize two confirmatory domains of progress:[3] progress in math and overall academic progress.

Math Progress

MAPS was designed to provide an incentive for students to take and complete their required math courses, starting with Beginning Algebra, then progressing through Intermediate Algebra, and eventually completing at least one college-level math course. Faster progress in math could be achieved by getting a greater proportion of students to attempt (and pass) math courses or by increasing pass rates among students who attempt math courses. Math progress is examined by looking at student success in key math classes in and beyond the developmental course sequences. A summary measure of math progress — the number of credits students earn in math courses, including both developmental and college-level courses — is also used.[4] Improved math progress and completion was the main goal of MAPS.

Overall Academic Progress

Also of importance is whether MAPS improves students' overall progress toward a degree. MAPS could improve students' overall progress by improving their progress in math and without impeding progress in non-math courses. MAPS could also improve students' overall progress by improving their progress in math, which in turn could have positive spillover effects in other subject areas. It is also plausible, although not intended, that MAPS could have a positive effect on students' math progress and a negative effect on progress in other subject areas if, for example, students took fewer non-math courses or focused their time and attention on math to the detriment of their other courses, yielding no overall benefit, simply a substitution of credit types. Thus it is critical to consider students' academic progress in non-math courses and their overall academic progress when interpreting the effect of MAPS on math progress. There is no perfect measure of overall academic progress, only useful proxies. This report's

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[3]Confirmatory outcomes are prespecified tests of the study's central hypothesis.

[4]Math credits earned was prespecified as the confirmatory indicator of progress in math. For an explanation of the difference between confirmatory and exploratory outcomes, see Schochet (2008). Examining program effects on math progress using math course completions or math credit accumulation provides qualitatively similar findings. Consequently, course completions are frequently presented for ease of exposition.

proxy is calculated by summing together all credits earned, including math and non-math credits that are either developmental or college-level credits.

Detailed Findings

Presented first is the effect of MAPS on the full research sample during the first two years after students entered the study.[5] Full sample results begin with students' progress in specific math courses (shown in Table 4.1) and then describe students' math, non-math, and overall credit accumulation (shown in Table 4.2). Findings are presented for the full sample, after which the results are disaggregated to understand whether the program's effects varied for different student subgroups. (Refer to Box 3.1 in Chapter 3 for information about how to read the tables presented in this report.)

Table 4.1 depicts students' progress in math courses during the first two years after students entered the study. Results are arranged in four panels: The first panel presents outcomes after the first semester in which students were part of the study — their first program semester, either a fall or a spring term. The second panel presents cumulative results after students' first full academic year in the study; this includes a fall, spring, and summer semester for all students, regardless of whether they entered the study in the fall or spring semester. The third panel presents cumulative findings after the first full academic year plus one semester. This represents the end of the MAPS program semesters, when scholarship dollars were available to students based on meeting the MAPS benchmarks. Finally, the last panel presents cumulative findings after two full academic years in the study, including two fall, spring, and summer semesters. The two-year mark includes one semester and one summer session after MAPS was complete.[6] Figure 4.1 provides a visual display of these time periods for the three cohorts in the evaluation.[7]

[5]The analyses presented in this chapter include all program group students and all control group students, unless otherwise noted. That is, the analyses are what researchers refer to as intent-to-treat (ITT), as described in principle in Bloom (1984).

[6]For the third cohort of students, data were not available for the final summer of the two-year follow-up. For these students, the final panel includes only fall, spring, summer, fall, and spring. Since few credits are attempted and earned during the second summer of study, it is expected that this has a negligible influence on the presented data.

[7]Different time periods are used in the analyses presented in Chapters 3 and 4. In Chapter 3, spring and summer semesters are always combined when counting semesters following random assignment. In Chapter 4, spring and summer semesters are treated separately for the spring 2011 cohort in order to calculate more comparable estimates of program effects across all cohorts. Figures 3.1 and 4.1 illustrate the differences between the time periods used in the two chapters.

The Performance-Based Scholarship Demonstration

Table 4.1

Math Course Progress (Cumulative)

Hillsborough Community College

Outcome (%)	Program Group	Control Group	Difference	Standard Error
First semester				
Beginning Algebra				
Registered	92.5	82.5	10.0 ***	2.0
Passed	55.9	45.7	10.2 ***	3.1
Received "A" or "B"	40.4	33.0	7.4 **	3.0
Intermediate Algebra				
Registered	0.0	0.0	0.0	
Passed	0.0	0.0	0.0	
Received "A" or "B"	0.0	0.0	0.0	
College-level math				
Registered	0.1	0.0	0.1	
Passed	0.0	0.0	0.0	
Received "A" or "B"	0.0	0.0	0.0	
First year				
Beginning Algebra				
Registered	95.0	91.2	3.8 **	1.6
Passed	65.5	59.8	5.7 *	3.1
Received "A" or "B"	46.3	43.0	3.3	3.1
Intermediate Algebra				
Registered	55.0	43.9	11.1 ***	3.1
Passed	39.0	28.1	10.9 ***	3.0
Received "A" or "B"	25.7	18.2	7.4 ***	2.6
College-level math				
Registered	13.4	8.3	5.1 **	2.0
Passed	10.0	6.7	3.3 *	1.8
Received "A" or "B"	5.3	4.6	0.7	1.4
First year and one semester				
Beginning Algebra				
Registered	95.6	91.9	3.7 **	1.5
Passed	67.9	62.7	5.2 *	3.0
Received "A" or "B"	47.4	45.0	2.4	3.1
Intermediate Algebra				
Registered	61.0	52.6	8.4 ***	3.1
Passed	45.0	34.6	10.4 ***	3.1
Received "A" or "B"	27.0	21.2	5.7 **	2.7
College-level math				
Registered	34.7	25.0	9.7 ***	2.9
Passed	26.2	20.3	5.9 **	2.7
Received "A" or "B"	13.5	13.7	-0.2	2.2

(continued)

Table 4.1 (continued)

Outcome (%)	Program Group	Control Group	Difference	Standard Error
First two years				
Beginning Algebra				
Registered	95.8	92.4	3.4 **	1.5
Passed	69.0	64.5	4.5	3.0
Received "A" or "B"	48.2	45.7	2.4	3.1
Intermediate Algebra				
Registered	63.0	56.1	6.9 **	3.1
Passed	48.4	37.8	10.7 ***	3.1
Received "A" or "B"	28.0	22.2	5.8 **	2.7
College-level math				
Registered	41.3	32.1	9.2 ***	3.1
Passed	31.9	26.4	5.6 *	2.9
Received "A" or "B"	16.9	17.7	-0.7	2.4
Highest level of math passed				
None	30.8	35.2	-4.4	3.0
Beginning Algebra	20.4	27.0	-6.5 **	2.7
Intermediate Algebra	16.8	11.4	5.4 **	2.3
College-level math	31.9	26.4	5.6 *	2.9
Sample size (total = 1,075)	674	401		

SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Beginning Algebra is a 4-credit developmental course. Intermediate Algebra is worth 3 college-level credits. College-level math courses are worth 3-5 college-level credits.

To pass Beginning Algebra and Intermediate Algebra, students must earn a grade of "C" or higher. To pass college-level math courses, students must earn a grade of "D" or higher.

Students may have registered for multiple college-level math courses in the same semester. Students are flagged as "passed" as long as they passed one college-level math course.

Math Progress

First Semester

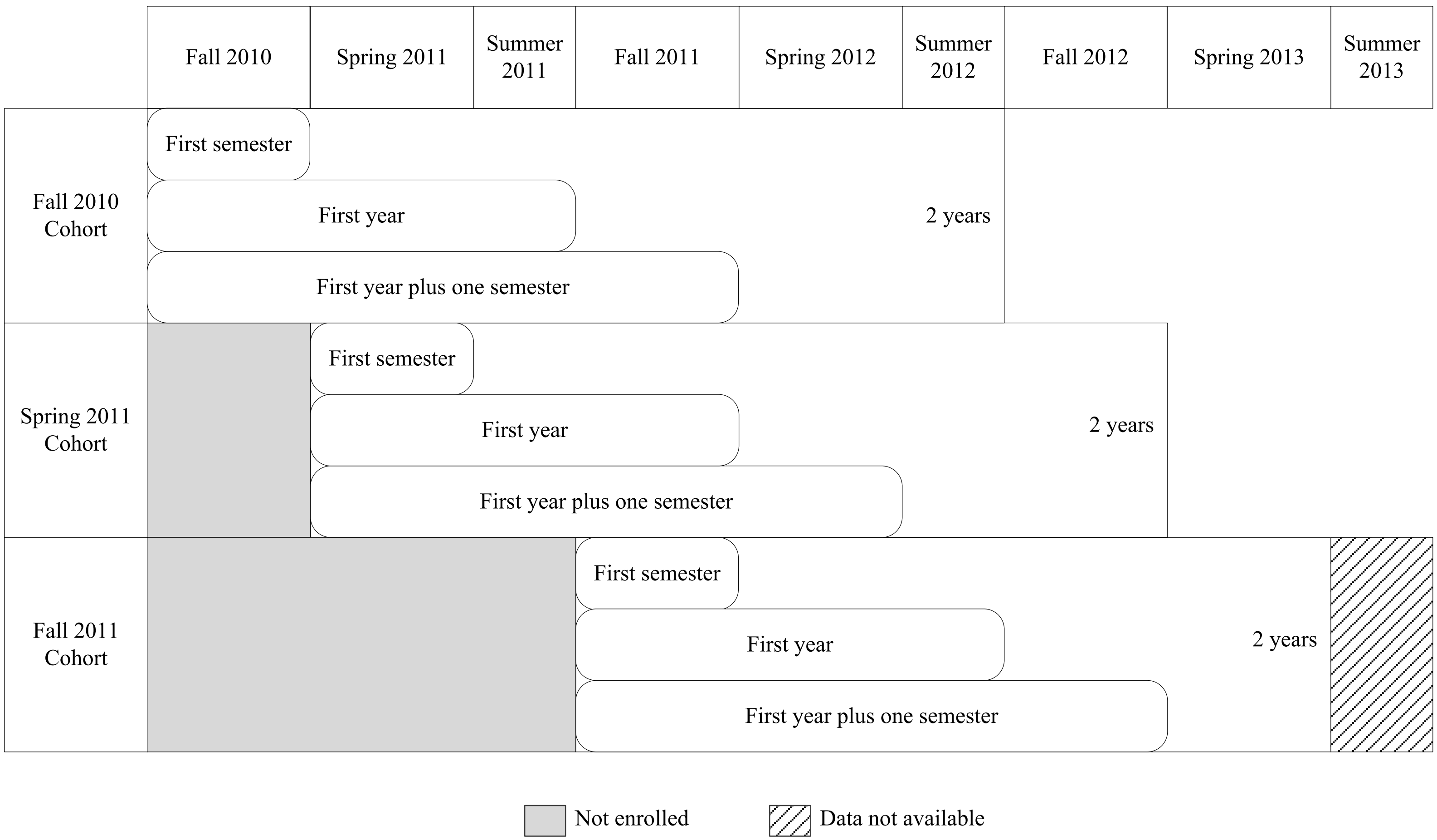
Recall that all study participants needed to enroll in Beginning Algebra. This is the first course for which program group students could receive scholarship payments — $100 for enrolling in the course and $500 for visiting the Math Lab and completing the course with a grade of “C” or better. In the absence of MAPS, 82.5 percent of control group students registered for Beginning Algebra. With MAPS, program group students registered at a rate of 92.5

The Performance-Based Scholarship Demonstration

Figure 4.1

Time Periods Used in Chapter 4

Hillsborough Community College



percent. The difference, 10.0 percentage points, represents the estimated effect of offering MAPS on students' likelihood of registering for Beginning Algebra during the first program semester. Tying this back to the program's intent to decrease learning loss by getting students to enroll immediately in math courses, in the first semester the program succeeded in getting a group of students who otherwise would have put off their first math class to take it immediately. This initial effect on enrollment is critical since a program that increases the percentage of students who attempt Beginning Algebra can also have an impact on the percentage of students who complete the course, even if pass rates are unaffected.

In this case, 55.9 percent of all program group students passed Beginning Algebra compared with 45.7 percent of all control group students.[8] The estimated effect, 10.2 percentage points, corresponds to a 22 percent increase above the base of 45.7 percent. The program's estimated effect on passing Beginning Algebra was a result of both increased attempts and increased rates of passing among those who attempted the course. Among program group members who took the course, 60 percent passed. Among control group members who took the course, 55 percent passed.[9] The program's first semester effect on pass rates in Beginning Algebra is important because progressing in math is the main focus of MAPS. That said, there is still much room for improvement — 44 percent of program group students had not passed Beginning Algebra by the end of their first semester.

One way to think about the impact on students' completing Beginning Algebra is to consider how many additional students are estimated to have completed the course as a result of MAPS. In this evaluation, there are 674 program group members, and the estimated effect of MAPS on completing Beginning Algebra is 10.2 percentage points. Thus, it is estimated that MAPS caused 69 more program group students (674 multiplied by 0.102) to pass Beginning Algebra in their first semester than would have been expected to pass had those 674 students not been offered MAPS.

Not only did MAPS result in more students registering for and passing Beginning Algebra, it also increased rates of receiving an "A" or "B" in Beginning Algebra by 7.4 percentage points — another outcome for which the program provided a direct incentive.

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[8]The denominator in these calculations includes all study participants, including those who did not enroll in the Beginning Algebra course.

[9]Program and control group differences in pass rates among those who attempted the course are not experimental and are not shown in the table. They can be calculated as 55.9/92.5 for program group members and 45.7/82.5 for control group members. The different pass rates between program and control group members may reflect the effectiveness of MAPS or differences in the types of students who took the course (or both).

First Year

The second panel in Table 4.1 shows students' cumulative progress through an academic year in MAPS, comprising a fall, spring, and summer term. Looking across the math courses, a clear picture unfolds: students in MAPS made significantly more progress through the math course sequence than did their control group counterparts. With respect to Beginning Algebra, compared with the magnitude of the estimated effects in the first panel of the table, the estimated effects are smaller in the second panel, a result of the fact that more control group students passed this course in the interim, a time period when a greater percentage of program group students had already moved on to the next course. The positive impact estimate (5.7 percentage points) on passing Beginning Algebra shows that the control group still did not fully catch up on this outcome. Meanwhile, during the time that control group students were narrowing the gap in passing Beginning Algebra, 11.1 percentage points more program group students took Intermediate Algebra, and 10.9 percentage points more passed Intermediate Algebra, showing that MAPS students made significantly more progress in the next stage of the course sequence than they would have in the absence of the program. Finally, after one year, including a fall, spring, and summer semester, more students who were offered MAPS had registered for (13.4 percent) and passed (10.0 percent) college-level math than their control group counterparts (8.3 percent and 6.7 percent, respectively).

First Year and One Semester

The third panel in Table 4.1 shows students' cumulative progress in math through an entire academic year in MAPS, comprising a fall, spring, and summer term, plus one additional semester (either a fall or a spring semester, depending on the cohort). Comparing the second and third panels provides a sense of students' progress during the additional semester, the final semester of the program. With respect to passing Beginning Algebra and Intermediate Algebra, the program effects were fairly stable at this point. With respect to college-level math, by the end of MAPS, 26.2 percent of program group members passed a college-level math course compared with 20.3 percent of control group members, for an estimated effect of 5.9 percentage points. After one year and one semester, MAPS students maintained an advantage in their math course sequence.

First Two Years

The final panel of Table 4.1 shows the cumulative effect of the opportunity to participate in MAPS after two full years. Comparing the third and fourth panels shows little change in terms of both outcome levels and impact estimates, with the exception that the outcome levels in college-level math improved for both program and control group members. The overall story remains the same — program group students progressed further in their math course sequence.

The final portion of the fourth panel presents one additional summary measure: the highest level of math passed. This provides a sense of the distribution of where students were in their math progress at the end of the follow-up period. After two years, 26.4 percent of control group members had passed a college-level math class compared with 31.9 percent of program group members. MAPS is estimated to have increased students' chances of completing college-level math by 5.6 percentage points. Another way to look at math progress is to note that MAPS is estimated to have moved 11.0 percent of students (5.4 plus 5.6) from not having completed any math or having only completed Beginning Algebra to having completed Intermediate Algebra or having completed college-level math.[10] The program had a clear, positive effect on students' math progress during the two year follow-up; nonetheless, the majority of MAPS students (51.2 percent) still had not completed Intermediate Algebra, let alone a college-level math course, two years after entering the study.

Credit Accumulation

Table 4.2 depicts students' cumulative credits attempted and earned during the first two years after entering the study. Credits are shown in total as well as disaggregated into math and non-math credits. The four panels in Table 4.2 represent the same time frames as in Table 4.1.[11]

First Semester

In terms of math credits, the program's estimated effect on both credits attempted and earned is 0.4 credit. Program group students earned an average of 2.3 math credits whereas control group students earned an average of 1.8 credits.[12] The estimated program effect represents a 22 percent increase in math credits earned resulting from MAPS. This corresponds to the results presented in Table 4.1, which showed that MAPS students took and completed Beginning Algebra at a higher rate than their control group counterparts.

Although MAPS was designed to improve math progress, it is important to consider whether progress in math came at the expense of progress in non-math courses. The first panel of Table 4.2 shows no discernible evidence that MAPS decreased students' progress in their non-math courses, as illustrated by the positive, though statistically insignificant, estimated effect on non-math credits earned. (The estimated effect is 0.3 non-math credit earned.) Combining math credits and non-math credits yields total credits, a proxy for students' overall academic progress. The program's estimated effect on total credits earned in the first semester is

[10]This assumes that MAPS did not have a negative effect on any students' outcomes.
[11]Appendix Table C.1 provides more detailed information that corresponds to Table 4.2.
[12]Rounding may cause slight discrepancies in sums and differences.

The Performance-Based Scholarship Demonstration

Table 4.2

Credits Attempted and Earned (Cumulative)

Hillsborough Community College

Outcome	Program Group	Control Group	Difference	Standard Error
First semester				
Total credits attempted	10.7	10.5	0.3	0.2
Math	3.7	3.3	0.4 ***	0.1
Non-math	7.0	7.1	-0.1	0.2
Total credits earned	7.5	6.8	0.7 **	0.3
Math	2.3	1.8	0.4 ***	0.1
Non-math	5.3	5.0	0.3	0.2
First year				
Total credits attempted	21.6	20.7	0.9	0.6
Math	6.8	5.9	0.9 ***	0.2
Non-math	14.8	14.8	0.0	0.5
Total credits earned	15.0	13.7	1.3 **	0.6
Math	4.1	3.5	0.7 ***	0.2
Non-math	10.9	10.3	0.6	0.5
First year and one semester				
Total credits attempted	27.6	26.3	1.4 *	0.8
Math	8.4	7.3	1.1 ***	0.2
Non-math	19.3	19.0	0.3	0.7
Total credits earned	19.2	17.6	1.5 *	0.9
Math	5.0	4.3	0.8 ***	0.3
Non-math	14.1	13.4	0.8	0.7
First two years				
Total credits attempted	33.2	31.6	1.7	1.1
Math	9.5	8.5	1.0 ***	0.3
Non-math	23.7	23.1	0.6	0.9
Total credits earned	23.1	21.5	1.6	1.1
Math	5.6	4.9	0.7 **	0.3
Non-math	17.5	16.6	0.9	0.9
Sample size (total = 1,075)	674	401		

SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

0.7 credit, a statistically significant effect representing a 10 percent increase over the control group base of 6.8 credits. Fifty-nine percent of the estimated impact on total credits earned was a result of additional math credits earned.

First Year

In terms of cumulative math credits, the program's estimated effect on credits attempted and earned is 0.9 and 0.7, respectively, at the one-year mark. By the end of the first year, MAPS students earned an estimated 20 percent more math credits than they would have in the absence of the program.

The program's estimated effect on total credits earned after the first year is 1.3 credits, representing a 9 percent increase over the control group base of 13.7 credits. As before, there is no evidence that MAPS had a deleterious effect on students' non-math progress, as revealed by the larger estimated effect on total credit accumulation than the estimated effect on math credit accumulation alone.

First Year and One Semester

After one year and one semester, the estimated effect of MAPS on math credit accumulation remained about the same, at 0.8 credit, indicating that at this point program group students and their control group counterparts were progressing at about the same rate. As a result, program students remained ahead of control group students in their progress in the overall course sequence. The estimated effect on total credits earned after the first year and one semester increased to 1.5 credits, slightly above that of the one-year mark.

First Two Years

At the end of two years, the effect on math credit accumulation was 0.7 credit. The fact that this impact remained remarkably stable from the one-year mark onward indicates that early on in MAPS, program group students earned more math credits than did their control group counterparts. Then, in later semesters, the program and control groups each earned math credits at about the same rate. The control group did not catch up, nor was the gap widened; rather, the program's early positive effect on math credit accumulation was maintained over two years. Appendix Table C.2 provides information similar to that depicted in Table 4.2, except that it depicts each semester's results separately and noncumulatively. Results in this format support the conclusion above — positive early effects are maintained, but do not grow — and they may be of interest to readers of past MDRC reports that frequently show results in this format.

With respect to non-math credits, at the end of two years, control group students earned an average of 16.6 credits and program group students earned an average of 17.5 credits. While the positive estimated effect of 0.9 credit is not statistically significant, it certainly does not provide any evidence that MAPS had a deleterious effect on non-math credit accumulation.

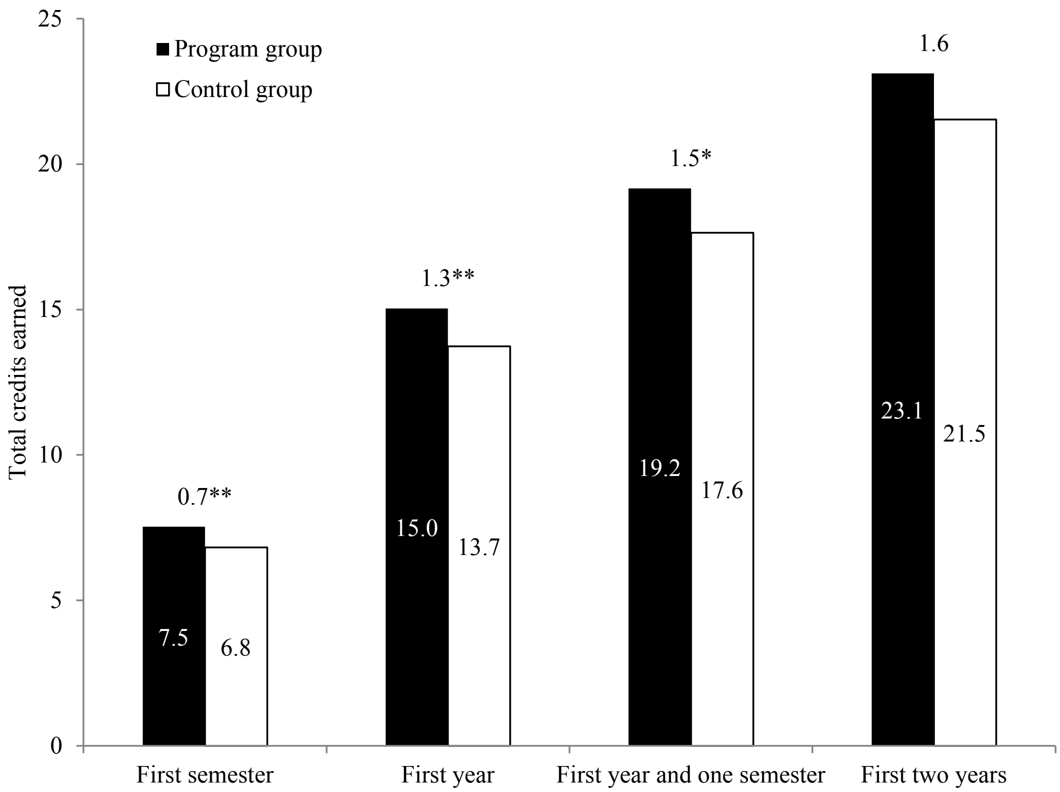
Finally, after two years, control group students earned an average of 21.5 total credits and program group students earned an average of 23.1 credits. Figure 4.2 plots cumulative credits earned over time, providing a visual depiction of this outcome measure. Although not

The Performance-Based Scholarship Demonstration

Figure 4.2

Total Credits Earned After Two Years

Hillsborough Community College



SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

statistically significant, the program's estimated effect on total credits earned after two years is 1.6 credits, with a 90 percent confidence interval ranging from -0.3 to 3.5 total credits. The lack of statistical significance suggests that caution should be used in claiming that MAPS had a positive effect on total credit accumulation, and thus overall academic progress, at the end of the study period. However, despite the lack of statistical significance at the final time point, the claim seems warranted because (1) the estimated effect of MAPS on cumulative total credits earned is positive and statistically significant during all three preceding time points, (2) the estimated effect on total credit accumulation increased at each successive time point,[13] and (3) there is clear evidence that MAPS had a positive effect on math credit accumulation and no discernible evidence that MAPS had a negative effect on non-math credit accumulation. Taken together, this evidence suggests that MAPS improved students' overall academic progress, in part because of its positive effect on progress in math — 46 percent of the estimated effect on total credits is attributed to math credits.

Notably, despite the program's clear positive effect on math progress and evidence of an effect on overall progress, there is no evidence of a discernible effect on persistence, as shown in Appendix Table C.2.

Subgroup Findings

In addition to estimating the overall effectiveness of MAPS, the program's effects for different types of students are of interest. Hidden in the overall average results presented above is the possibility that MAPS may be more or less effective for certain types, or subgroups, of students.

Two subgroups of students were prespecified as being of particular interest for subgroup analyses because of logical hypotheses that MAPS may be more effective for one group than another. The first hypothesis is that MAPS may be more effective for students who are financially independent. The theory is that a monetary incentive, on average, may be a greater and more salient motivator for students who are primarily responsible for their own financial situation. The importance of and relationship to money may be different for students who are in charge of their own fiscal matters. Consequently, the response of, and effects on, students who are offered a monetary incentive may vary based on this characteristic.

[13]It is somewhat counterintuitive that the estimated impact at the end of two years can be greater than the estimated impact at the end of the first year plus one semester, and yet the latter is statistically significant and the former is not. The reason for this is that the standard error, a measure of uncertainty of the estimated impact, is larger at later time points because the variance of cumulative credits earned increases over time.

The second hypothesis, generated by staff members at HCC, is that MAPS may be more effective for students who have not been in a math classroom for some time. Such students may have experienced significant learning loss. Thus, an incentive to get back into mathematics and to take advantage of the Math Labs for support might prove especially effective for these students, compared with students who did not experience any delay between taking their previous math classes and enrolling in the program. Unfortunately, no measure of "time since taking last math class" is readily available at baseline, so, instead, two proxies are used. The first one is a binary indicator of whether students enrolled in the evaluation more than a year following the date when they received their high school diploma or GED certificate.[14] The second one is a binary indicator of whether a student was age 20 or older upon entering the study. While these measures do not correspond perfectly with the construct of interest, they serve as proxies.

In addition to exploring the program's effects on these subgroups, which were selected based on theory, the study examines the effects based on students' race and gender. Although a variety of hypotheses can be imagined for why MAPS might have differential effects based on race and gender, these subgroups are explored primarily because of their political importance. Policymakers and researchers are often interested in whether program effects vary by race and gender owing to historical disadvantages experienced by different groups and achievement gaps with respect to education.

Table 4.3 summarizes the program's cumulative estimated effects on math credits earned at the end of two years by the five different subgroups: (1) financial dependence, (2) greater than one year since receipt of a high school diploma or GED certificate, (3) age 20 years or older, (4) gender, and (5) race/ethnicity.[15] The results suggest that the effectiveness of MAPS varied: MAPS may be particularly effective for certain types of students and have minimal or no effect on others. For example, as hypothesized, financially independent students appear to have benefited more from MAPS than financially dependent students

[14]This is an imperfect measure because many students entered the MDRC study as continuing students, so although they may have entered the study a year or more after graduating from high school or earning a GED certificate, they may have been enrolled in college during that year and they may even have taken a math class during that time period.

[15]The first two subgroups listed were prespecified as confirmatory in an analysis plan that was developed before examining the results. These two groups were prespecified based on an assessment concluding that the theory about possibly differential effects was stronger for these groups. The general approach of prespecifying a very small number of subgroups as confirmatory is an attempt to reduce the multiple hypotheses testing problem — that is, the problem that conducting many hypothesis tests can lead to spurious findings. Multiple hypothesis testing adjustments were not conducted.

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Table 4.3

Variation in Program Effects on Number of Math Credits Earned After Two Years, by Student Characteristics

Hillsborough Community College

Characteristic	Sample Size	Program Group	Control Group	Difference	Standard Error	Difference Between Subgroups	Subgroup Difference P-value
Financial dependence[a]						††	0.0474
Independent	652	6.0	4.9	1.0 ***	0.4		
Dependent	368	5.0	5.3	-0.3	0.6		
Greater than one year since high school/GED						†††	0.0008
Yes	844	5.8	4.6	1.1 ***	0.3		
No	192	4.5	6.3	-1.8 **	0.8		
Age 20 years or older						††	0.0145
Yes	824	5.9	4.8	1.1 ***	0.3		
No	251	4.8	5.5	-0.7	0.7		
Gender							0.3824
Male	362	5.6	4.4	1.2 **	0.6		
Female	713	5.7	5.1	0.6 *	0.4		
Race/ethnicity[b]						††	0.0107
Hispanic	325	5.2	5.5	-0.3	0.5		
White	323	5.9	5.7	0.3	0.6		
Black	351	5.7	4.0	1.7 ***	0.5		
Other	60	6.3	2.1	4.2 **	1.8		

(continued)

Table 4.3 (continued)

SOURCES: MDRC calculations from Hillsborough Community College transcript data and Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

The H-statistic test was used to test for statistically significant differences in impact estimates across different subgroups. Statistical significance levels are indicated as follows: ††† = 1 percent; †† = 5 percent; † = 10 percent.

Two years of data represents two fall semesters, two spring semesters, and two summer semesters for the fall 2010 and spring 2011 cohorts, and two fall semesters, two spring semesters, and one summer semester for the fall 2011 cohort.

[a]Students were counted as financially independent if they met any one of the following criteria as of random assignment: they were age 24 years or older, they were married, or they had one child or more.

[b]Respondents who said they are Hispanic and chose a race are included only in the Hispanic category. Respondents who said they are not Hispanic and chose more than one race are included in the Other category. These respondents, combined with those who said they were Asian, American Indian or Alaska Native, or another race/ethnicity, are included in Other.

(estimated impacts of 1.0 math credit and negative 0.3 math credit, respectively). Similarly, as hypothesized, MAPS had a positive and significant effect on students who graduated from high school or earned a GED certificate more than one year before entering the evaluation, and this effect is statistically significantly different from the estimated effect for students who recently graduated or earned a GED certificate (estimated impacts of 1.1 math credits and negative 1.8 credits, respectively).

Surprisingly, MAPS is estimated to have had a negative effect on the small proportion of the sample that recently graduated from high school or earned a GED certificate. This group includes only 192 students, a small sample, and the standard error is quite large. However, caution may be warranted when considering offering MAPS to this subgroup of students.

MAPS may have also been more effective for students age 20 years or older. Since the students in this study who are financially independent are also disproportionately those who graduated from high school more than one year before random assignment, and, further, are also disproportionately students who are age 20 years or older, these subgroup findings are likely related. Indeed, 54 percent of the sample falls into all three groups, while 11 percent falls into none. A future report synthesizing findings across MDRC's Performance-Based Scholarship Demonstration will examine the issue of differential effects based on financial dependence.

In other key subgroups of interest, analysis finds no evidence that MAPS has a differential effect for men compared with women; rather, it has a positive effect for both groups. By contrast, analyses suggest that MAPS was most effective for black students and students who responded that they were Asian, American Indian or Alaska Native, multiracial, or another race/ethnicity (listed as "Other"), compared with those who responded that they were white or Hispanic. The evidence of differential effects based on race does not correspond with findings from other studies of the effects of performance-based scholarships, and thus caution is urged when considering these observed differences.

The general pattern of subgroup findings is confirmed in Table 4.4, which examines the same subgroups with respect to total credits earned. Should the subgroup findings presented in this report be confirmed in future studies involving financial incentives for community college students, an argument could be made for the careful targeting of financial incentives toward those students who benefit most from these incentives. For now, these findings remain exploratory and warrant further investigation.

The Performance-Based Scholarship Demonstration

Table 4.4

Variation in Program Effects on Number of Total Credits Earned After Two Years, by Student Characteristics

Hillsborough Community College

Characteristic	Sample Size	Program Group	Control Group	Difference	Standard Error	Difference Between Subgroups	Subgroup Difference P-value
Financial dependence[a]						†	0.0532
Independent	652	23.6	20.7	2.9 **	1.5		
Dependent	368	22.1	24.1	-2.0	2.1		
Greater than one year since high school/GED						††	0.0156
Yes	844	22.9	20.0	2.9 **	1.3		
No	192	22.5	28.0	-5.5 *	3.2		
Age 20 years or older						†	0.0618
Yes	824	23.2	20.4	2.8 **	1.3		
No	251	22.8	25.4	-2.5	2.6		
Gender							0.2330
Male	362	24.0	20.1	3.9 *	2.2		
Female	713	22.8	22.0	0.8	1.3		
Race/ethnicity[b]						††	0.0317
Hispanic	325	20.4	23.1	-2.7	2.0		
White	323	23.9	22.0	1.8	2.3		
Black	351	25.0	20.2	4.8 **	2.1		
Other	60	25.5	14.3	11.3	7.4		

(continued)

Table 4.4 (continued)

SOURCES: MDRC calculations from Hillsborough Community College transcript data and Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

The H-statistic test was used to test for statistically significant differences in impact estimates across different subgroups. Statistical significance levels are indicated as follows: ††† = 1 percent; †† = 5 percent; † = 10 percent.

Two years of data represents two fall semesters, two spring semesters, and two summer semesters for the fall 2010 and spring 2011 cohorts, and two fall semesters, two spring semesters, and one summer semester for the fall 2011 cohort.

[a]Students were counted as financially independent if they met any one of the following criteria as of random assignment: they were age 24 years or older, they were married, or they had one or more children.

[b]Respondents who said they are Hispanic and chose a race are included only in the Hispanic category. Respondents who said they are not Hispanic and chose more than one race are included in the Other category. These respondents, combined with those who said they were Asian, American Indian or Alaska Native, or another race/ethnicity, are included in Other.

Summary

MAPS led more students to take math courses, complete math courses, and continue to enroll in the next course in the sequence. MAPS's success did not come at the detriment of students' progress in other subject areas; in fact, the program appears to have helped students make greater overall progress toward a degree. There is suggestive evidence that MAPS may have been more effective for certain types of students — a finding that should be explored in more depth in future evaluations of financial incentives for community college students.

Chapter 5

Cost-Effectiveness of MAPS

This chapter is designed to address questions regarding the decision to invest in the Mathematics Access Performance Scholarship (MAPS) program at Hillsborough Community College (HCC). The discussion identifies the cost of MAPS, including a detailed examination of the various component costs associated with the program. Additionally, the total cost of college for students who are eligible for MAPS is compared with the cost of the usual college experience without MAPS. Last, the total cost of college for both groups and student success outcomes are compared to explore how the performance-based scholarship program at HCC changes the cost per outcome achieved — specifically, whether the investment in the program produced more desired outcomes per dollar than the usual college services.[1]

The key findings are the following:

- **Scholarship payments made up the majority of program cost.**

The direct cost to operate MAPS at HCC was just under $1,400 ($1,394) per program group member. Most of this money (64 percent) was associated with transfers to students in the form of scholarship payments and book vouchers. Just over 25 percent of the program cost was associated with program administration and 10 percent was associated with increased Math Lab costs.

- **When the additional costs of educating students are considered, over the two years of follow-up, the college invested between $1,394 and $1,863 more per program group member than it did per control group member.**

This estimate includes the direct cost to operate the program plus an estimate of the cost associated with program students' attempting more college courses, which has a low-end cost estimate of $0 and a high-end cost estimate of approximately $469 per program group member.

- **The cost-effectiveness findings on MAPS are mixed and vary by outcome. MAPS is able to lower the cost per college-level math course com-**

[1]It is possible to lower the cost per outcome achieved while increasing total costs. The analysis compares alternative strategies to achieve a designated goal and the result is always relative — that is, one program lowers the cost per outcome achieved when compared with another. In this case the program is compared with the usual college services. Each alternative requires resources to produce its respective results. The comparison aims to highlight which strategy or alternative produces the most positive outcomes per dollar of investment.

pletion when compared with the usual college experience but does not lower the cost of math and total credits earned.

The analysis shows that the $1,394 to $1,863 of additional investment in each program group member resulted in a 5.6 percentage point increase in the likelihood of completing a college-level math course. This impact is large enough that when costs (direct program costs plus the cost of credits attempted by students over two years) are tied to the number of college-level math course completions, the program lowers the cost per outcome achieved in comparison with the usual college services without the program. Specifically, the cost per college-level math course completion for the program group is between $126 and $1,594 less (or up to 5 percent less) than the cost per college-level math course completion for the control group. The program also resulted in students earning 0.7 more math credit and 1.6 more credits overall; these impacts were not large enough, however, to lower the cost per math credits or total credits earned.

Methodology

This chapter describes the cost of scholarship payments and estimates the cost-effectiveness of MAPS at HCC between July 2010 and January 2013. All costs are considered from the perspective of the college. College-level spending includes resources from a spectrum of stakeholders including students, private donors or foundations, local taxpayers, and state and federal government. These costs are estimated using college financial information. Since all funds (such as tuition paid by students, subsidies from various government entities, and private donations) are funneled through the college, this approach provides a good estimate of the total investment being made in these community college students. The analysis aims to exclude costs that are not part of the "steady state" of operation of MAPS; as a result, start-up and research costs have been excluded.[2] See Appendix D for definitions of the terms used throughout this chapter.

Direct Cost

The *direct cost* accounts for the resources that are required to operate MAPS during the period of program operation. In this analysis, the period of program operation spanned three semesters and one summer semester. As outlined in Figure 5.1, the direct cost of MAPS was approximately $1,394 per program group member. The majority (64 percent) of these costs went directly to students as transfers in the form of scholarship payments and textbook vouchers.

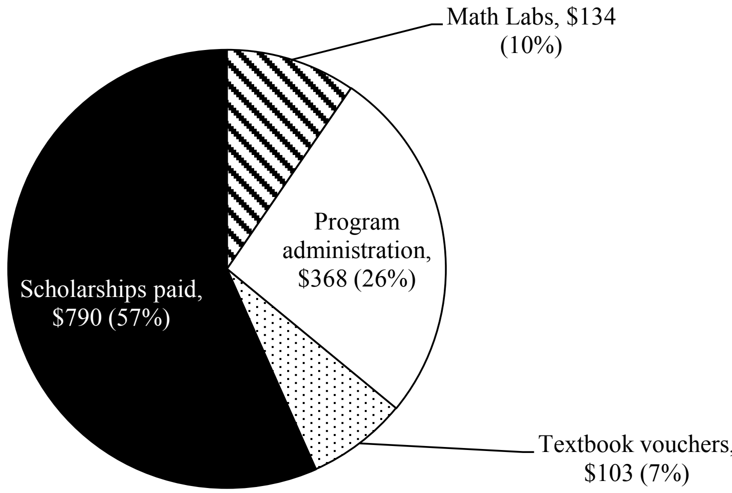
[2]For purposes of presentation all costs have been classified as either direct, base, or indirect costs. The sum of these component costs is the total cost. The difference between the program group's and control group's total costs is described as the net cost.

The Performance-Based Scholarship Demonstration

Figure 5.1

Direct Cost per Program Group Member

Hillsborough Community College



Total = $1,394 per program group member

SOURCE: MDRC calculations from MAPS program expenditures and Hillsborough Community College scholarship receipt data.

NOTES: Rounding may cause slight discrepancies in sums and differences. All dollar values have been rounded to the nearest whole dollar.

The time period for this analysis is July 2010 through January 2013. Program costs are based on a steady state of operation that excludes research and start-up costs.

Scholarship payments accounted for 57 percent of the program's direct cost, with students receiving approximately $790 on average. In addition, students received an average of $103 in textbook bonuses, accounting for about 7 percent of the program's direct cost. Program administration accounted for just over one-fourth (26 percent) of the program's direct cost. The bulk of program administration was associated with personnel expenses (22 percent of the total direct cost) while the remaining 4 percent of program administration covered student tracking and other expenses (3 percent and 1 percent of the total direct cost, respectively). Approximately 10 percent of the program's direct cost was related to Math Lab staffing expenses.[3]

[3]Program group members were required to visit the Math Labs at the Dale Mabry or Brandon campuses to earn the scholarship payments for the first two courses in the sequence. As a result of the increased demand (continued)

Scholarship Costs

Scholarship costs made up 57 percent of the direct costs incurred by MAPS, with the average student receiving $790 in scholarship payments. Therefore, of the potential $1,800 each student could have earned in scholarships, 44 percent of the scholarship amount offered was ever paid. Higher proportions of payments were made to students taking Beginning Algebra, while a smaller proportion went to students in Intermediate Algebra, and a still smaller proportion to students enrolled in college-level math. This means that a progressively larger portion of scholarships offered to students are being left unpaid. This disparity is largely a function of time and the nature of the hurdle. As time passes, fewer students enroll, which results in a lower percentage of scholarships offered being paid over time. Additionally, some hurdles are less likely to be surpassed than others. Understanding the relationship between scholarship amounts offered and paid in relation to various outcomes should help similar programs control costs and improve overall program efficacy.

Base Cost

In order to understand the context of program direct cost, this analysis estimates the cost of the usual college services provided to all students, whether or not they are in the program. This is also referred to as the *base cost*. Getting an accurate estimate of this cost can be challenging because of data limitations, so this analysis uses the estimated cost of credits attempted as a proxy for base costs. This approach assumes that resource use corresponds to the number of credits attempted; in other words, a student who attempts more credits is generally associated with greater expenditures than a student who attempts fewer credits.[4] To estimate the dollar value of credits attempted, the number of credits attempted is multiplied by an estimated cost per credit. This cost per credit is estimated by dividing the college's annual operating budget by total instructional activity (credit hours attempted) at the college during the year of interest. The average cost per credit yielded by this calculation is then used to estimate the cost of the usual

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that this requirement was expected to create, additional staff capacity was needed. Math Lab staff capacity was increased through the training and certification of tutors, the hiring of nine new tutors and increasing the hours of four existing staff members at Dale Mabry, and the hiring of seven tutors at the Brandon campus. Over the course of the analysis period, the program invested $90,000 in additional Math Lab staff on those two campuses to meet the predicted increase in demand. This represents an expenditure of $134 per program group member, or 10 percent of the program's total direct cost. Both program and control group members, as well as students who were not in the research sample, may have benefited from the additional staff made possible by this expenditure. This cost has been included in the analysis because it was incurred directly as a result of the program.

[4]However, it is possible that students use services such as advising and counseling independent of the number of courses in which they enroll.

college experience.[5] This approach is not perfect. One limitation is the assumption that all credits attempted have the same cost to the college, which is not necessarily the case.[6] For example, science lab courses may be more expensive than English courses. In order to use this approach, the analysis assumes that the average cost of an HCC student is representative of the average cost of a student in the sample. However, this seems to be a reasonable assumption for this analysis because the process of random assignment helps ensure that any differences in the cost of credits attempted compared with the average cost would occur equally in both the program and control groups. Estimating the base cost helps show how much money is spent to educate the typical sample member in the absence of the program.

Table 5.1 presents all of the costs used in this cost analysis, and calculates a net cost per group member. The first row reiterates the direct cost, discussed above. The second row of Table 5.1 presents the base cost of credits attempted at HCC. Control group members attempted an average of 31.6 credits in the two years of follow-up, for a total cost of credits attempted (credits attempted multiplied by cost per credit) of $8,959 per group member.[7] This represents the cost of the typical college experience in the absence of this program.

Indirect Cost

Indirect cost describes the cost associated with behavioral changes that are a result of the program. Tracking the indirect cost helps determine whether the intervention had any externalities that affected cost in the long term.[8] This analysis will consider indirect costs under two conditions, the first being indirect costs when marginal costs are equal to zero, and the second when marginal costs are equal to average cost per credit. A marginal cost equal to zero refers to a condition when colleges are fully able to absorb the cost of additional credits attempted by leveraging existing resources so there is no additional cost to the college (referred to

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[5]The total expenditures are divided by the total instructional activity provided at the school in the corresponding year to calculate the cost per instruction at a college. HCC, like many Florida state colleges, reports its yearly instructional activity in contact hours and credit hours. For ease of comprehension, the cost per total instructional activity is shown as cost per credit using an Integrated Postsecondary Education Data System (IPEDS) conversion where 30 credit hours or 900 contact hours are equivalent to one full-time equivalent student (FTE). The cost per credit at HCC was calculated to be $283.85.

[6]"Cost" in this case refers to the amount of resources dedicated to the course by the college; it is not necessarily connected to the price that students may be paying for that course.

[7]Rounding may cause slight discrepancies in cost calculations because impact data are rounded to one decimal place. Rounding may make some numbers appear slightly different from their Chapter 4 counterparts. All cost calculations used all four available decimal places in impact data for accuracy.

[8]An economic externality is a side effect or consequence of an activity that incurs costs or benefits not initially accounted for; in this example, indirect costs capture the externalities of the program by accounting for the increase in credits attempted by students over the two year follow-up period.

The Performance-Based Scholarship Demonstration

Table 5.1

Net Cost of Education per Sample Member

Hillsborough Community College

Feature ($)	Program Group	Control Group	Difference
Direct cost: cost of primary program components	1,394	0	1,394
Base cost: cost of credits attempted in the absence of the program	8,959	8,959	0
Indirect cost: cost of additional credits attempted because of program			
Marginal cost equal to zero[a]	0	0	0
Marginal cost equal to average cost[b]	469	0	469
Total cost			
Marginal cost equal to zero[a]	10,353	8,959	1,394
Marginal cost equal to average cost[b]	10,822	8,959	1,863

SOURCES: MDRC calculations from student level participation data, program-specific budget data, and Hillsborough Community College financial and enrollment data from the Integrated Postsecondary Education Data System (http://nces.ed.gov/ipeds/datacenter/).

NOTES: Rounding may cause slight discrepancies in cost calculations due to the rounding of impact data to one decimal place. All cost calculations used all four available decimal places in impact data for accuracy. All dollar values have been rounded to the nearest whole dollar.

Tests of statistical significance were not performed.

Program costs are based on a steady state of operation that excludes research and start-up costs.

Credits attempted include all college-level and developmental credits attempted.

[a]The condition of "marginal cost equal to zero" refers to the ability of existing college resources to absorb the additional credits attempted by the program group without incurring new costs to the college. Indirect cost under the condition when marginal cost equals zero represents the case where existing college resources can be leveraged to accommodate changes in credits attempted at no additional cost to the college.

[b]The condition of "marginal cost equal to average cost" describes a condition where existing college resources are unable to absorb the additional credits attempted by the program group without incurring new cost to the college. Indirect cost under the condition "marginal cost equal to average cost" represents the case where existing college resources cannot be leveraged to accommodate changes in credits attempted, therefore incurring additional costs to the college. The additional costs to the college, or the marginal cost of the additional credits attempted, is approximated as the average cost per credit attempted at the institution.

here as the "low-end" estimate). The low-end estimate would be reasonable if students attempted more credits by enrolling in a large lecture class where some seats are currently empty. Such a circumstance will not always be realistic; hence, the analysis includes an estimate where marginal cost is equal to average cost. A marginal cost equal to the average cost represents the case where existing resources are unable to absorb the cost of additional credits attempted because existing resources are already fully leveraged, meaning the college will require additional resources (referred to here as the "high-end" estimate). Since the analysis considers these two conditions, costs will be presented as ranges, representing the upper and lower bounds.

The third row of Table 5.1 shows the indirect cost of the program, or the cost associated with program group members' attempting more credits than control group members. Program group members attempted more credits than their control group counterparts in the two years of follow-up. On average, each program group member attempted 33.2 credits by the end of the follow-up period; this is 1.6 credits more than the average control group member attempted. Multiplying the additional 1.6 credits attempted by the corresponding cost per credit gives a high-end indirect cost of the program of $469 per program group member. The low-end indirect cost is $0, assuming that HCC can fully absorb the cost of additional credits attempted.

Net Cost

The *net cost* is defined as the difference between the program group cost and the control group cost. The costs of each group are presented in the total line of Table 5.1. Adding the direct cost, base cost, and indirect cost shows that the total cost of educating the average program group member over two years was between $10,353 and $10,822, while the total cost of educating the average control group member was $8,959. Over the two years of follow-up, the net cost can range from $1,394 to $1,863 per program group member.

Cost-Effectiveness Analysis

A cost-effectiveness analysis expresses the costs of alternative interventions as the cost per unit of a desired outcome.[9] This analysis considers the cost per college-level math course completion, the cost per math credit earned, and the cost per credit earned. Table 5.2 summarizes the results. The top row of Table 5.2 presents the total cost per group member. These values were described in the preceding "Net Cost" section of this chapter. The total cost per program group member ($10,353 to $10,822) is $1,394 to $1,863 more than the total cost per control group member ($8,959). The second row shows the percentage of program and control group members who completed college-level math. Specifically, 31.9 percent of program group members completed a college-level math course while 26.4 percent of control group members did so (as highlighted previously in Table 4.1). The next row presents the cost per college-level math completion for each group: $33,999 ($8,959/26.4 percent) per college-level math completion for the control group and $32,405 ($10,353/31.9 percent) to $33,873 ($10,822/31.9 percent) for the program group. The 5.6 percentage point increase in passing

[9]For additional explanation of this approach, see Sommo, Mayer, Rudd, and Cullinan (2012). A similar approach is also used in Levin and Garcia (2012).

The Performance-Based Scholarship Demonstration

Table 5.2

Cost-Effectiveness Values

Hillsborough Community College

Outcome	Program Group[a]	Control Group	Difference
Cost per group member ($)	10,353 to 10,822	8,959	1,394 to 1,863
Passed college-level math (%)	31.9	26.4	5.6 *
Cost per passed college-level math ($)	32,405 to 33,873	33,999	-1,594 to -126
Math credits earned	5.6	4.9	0.7 **
Cost per math credit earned ($)	1,836 to 1,919	1,826	10 to 93
Total credits earned	23.1	21.5	1.6
Cost per total credit earned ($)	448 to 468	416	32 to 52
Sample size (total = 1,075)	674	401	

SOURCES: MDRC calculations from program-specific participation and budget data, HCC transcript data, and Hillsborough Community College financial and enrollment data from Integrated Postsecondary Education Data System (http://nces.ed.gov/ipeds/datacenter/).

NOTES: Rounding may cause slight discrepancies in cost calculations due to the rounding of impact data to one decimal place. All cost calculations used all four available decimal places in impact data for accuracy. All dollar values have been rounded to the nearest whole dollar. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent. Tests of statistical significance have been performed on outcome measures, not costs. All outcomes are for the first two years (cumulative).

Program costs are based on a steady state of operation that excludes research and start-up costs.

[a]Program group costs are shown as a range where the lower bound represents the point at which marginal cost equals zero, and the upper bound represents the point at which marginal cost equals average cost.

college-level math was large enough to lower the cost per college-level math completion by up to 5 percent.[10]

A similar analysis is performed in relation to math credits earned and total credits earned. Cost-effectiveness results for math credits earned show that the program group cost per math credit earned is not lower than the cost per math credit earned without the program.[11]

[10]Costs have been calculated with upper- and lower-bound conditions; therefore the upper-bound cost lowers the cost per college-level math completion by less than 1 percent while the lower-bound cost decreases the cost per college-level math completion by approximately 5 percent.

[11]The cost of math credits earned is based on the entire cost of attending college, not simply the cost of math courses. If this exercise were conducted based on the estimated cost of math courses only, the cost per (continued)

Likewise, the program did not lower the cost per total credit earned.[12] Specifically, the cost per credit earned for the program group ranges from $448 to $468 compared with the control group cost per credit earned of $416, as shown in the last two rows of Table 5.2, a difference of 8 to 12 percent.

While the cost-effectiveness findings of MAPS are mixed, a college may opt to pay more for increased outcomes in order to achieve a greater rate of success at the expense of a higher cost per outcome. A college that places a high value on students' earning more credits would still view such a program as a wise investment if the college were willing to pay more for students to succeed in earning more credits.

In summary, the additional $1,394 to $1,863 invested in the program group members through the MAPS program yielded a 5.6 percentage point increase in the likelihood of completing college-level math, a 0.7 increase in math credits earned, and a 1.6 increase in total credits earned over the performance of the control group members.

Conclusion

The analysis shows that the $1,394 to $1,863 of additional investment in each program group member resulted in a 5.6 percentage point increase in the likelihood of completing a college-level math course. This impact is large enough that it lowers the cost per college-level math completion compared with the usual college services without the program. Specifically, the cost per college-level math completion for the program group is $126 to $1,594 (up to 5 percent) less than the cost per college-level math completion by the control group. This difference is important because it shows that while society did invest more resources in each program group member, the impact of the program on students' completing college-level math was large

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math credit earned for the program group would still not be lower than the cost per math credit earned for the control group.

[12]The fact that MAPS lowered the cost per outcome in terms of completing college-level math but not in total credits earned highlights the importance of the relationship between the percentage increase in cost and the percentage change for an outcome. For example, under conditions where marginal cost is equal to average cost, the increase in costs associated with MAPS incurred over the normal college experience is 20.8 percent. Meanwhile, the 5.6 percentage point increase in completing college-level math by program group students is a 21.2 percent change over control group students who completed a college-level math course. This 21.2 percent change is more than enough to account for the 20.8 percent increase in cost, and therefore MAPS lowers the cost per outcome with regard to the completion of a college-level math course. In the case of total credits, the total credits earned were 23.1 and 21.5 credits for the program group and control group, respectively. This impact of 1.6 credits is only a 7.4 percent change in total credits earned, not enough to overcome the 20.8 percent increase in costs incurred by MAPS. Therefore, MAPS does not lower the cost per outcome with regard to earning more total credits and similarly does not lower the cost per outcome in earning more math credits.

enough to lower the cost per outcome achieved compared with the usual college experience. When the cost is compared with other outcomes, such as math credits and total credits earned, the program is unable to lower the cost per outcome achieved. Depending on the value assigned to certain outcomes, such as math completion or total credits earned, producing a greater number of successful academic outcomes may be more important than lowering the cost per outcome.

Understanding how much is paid to produce various outcomes can yield useful information for entities that are considering designing contracts for programs where payment is based on achieving specific outcomes. Outcomes are already implicitly purchased; however, it often is not known how much is being paid per outcome because costs are generally viewed in terms of inputs, such as teacher instructional time. Cost-effectiveness analysis sheds light on how much is currently being spent to produce certain outcomes and how much specific programs spend to produce the same outcomes. Knowledge about outcome prices provides a starting point for a conversation about what is an appropriate price to achieve a specific goal.

The cost-effectiveness results show that HCC currently spends $33,999 per college-level math completion.[13] Since it already spends this much per college-level math completion, it may be reasonable for the college to pay a similar rate for increases in the number of college-level math completions. If HCC agreed to purchase increases in the number of college-level math course completions from MAPS at the same rate it currently pays, the payment would have been more than enough to cover the additional cost incurred due to MAPS.[14]

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[13]Value is based on the total cost of college for all students in the control group during the follow-up period divided by the number of control students who passed college-level math.

[14]The way that colleges are funded is a barrier to this type of contracting. Current funding systems generally do not pay based on outcomes but, rather, based on inputs (such as teacher instructional time) or outputs (such as the number of credits attempted), and it is difficult to enter into contracts that pay based on outcomes when funding is not allocated based on outcomes. If funding streams were reformed based on the principle of paying for outcomes, contracts similar to the example above would be much more appealing in many settings because revenues could be expected to change as the amount of desired outcomes that are produced change.

Chapter 6

Conclusion

The Mathematics Access Performance Scholarship (MAPS) program at Hillsborough Community College (HCC) was implemented to help low-income students requiring developmental math get through the developmental course sequence and pass a college-level math course. MDRC's evaluation of the program found that MAPS was successful at what it set out to do: move students further through the sequence. At the end of two years, program group students were more likely to have completed a college-level math course or Intermediate Algebra than were control group students.

As shown in prior chapters of this report, MAPS was implemented with fidelity to the model. When surveyed, program group students reported a high level of awareness of the scholarship requirements and said that the scholarship was useful to their academic success. In focus groups, students said that the scholarship kept them a bit more focused on doing well in math. MAPS requirements also exposed more program group students to the supports available in Math Labs to help them learn course material. Many said they would not have visited the labs otherwise, meeting a critical goal of the MAPS developers at HCC. Indeed, data from Math Lab visits indicates that program group students were more likely to visit the Math Labs than control group students.

While the program did not have a discernible effect on students' persistence during the first two years, it did have a positive effect on math progress. The impact findings in this report indicate that MAPS met its primary goal for math progress, as it got more students to take and pass math courses and to continue on to enroll in the next course in the sequence. Students in the program group also earned more total credits than did students in the control group over the follow-up period. The cost-effectiveness analysis tells a more nuanced story that varies depending on the primary outcome of interest. While MAPS lowered the cost per college-level math course completion, costs were higher per math credit and overall credit earned.

The findings at HCC align with those at other colleges in MDRC's Performance-Based Scholarship (PBS) Demonstration. By and large, the colleges in the demonstration have found that performance-based scholarships are able to improve some key academic outcomes, such as meeting the targeted academic benchmark and earning more credits. However, some academic outcomes remain mostly unaffected, such as student retention to the next semester. The findings at HCC, and across the demonstration, are modest but positive, indicating that performance-based scholarships can provide students with a small push in the right direction.

HCC's Math Lab requirement may raise the question of whether adding a service component to a performance-based scholarship is especially valuable for struggling students. The design of this study precludes the ability to separate the program's components to determine the relative value of each. Indeed, none of the individual PBS studies were designed to answer the question of service components' value. However, in a future report MDRC plans to use available data to look for lessons that may prove of use to the field on student service components.

Changes to Developmental Education

The results from this report indicate that MAPS can be a useful approach in affecting student behavior, though it does not fully solve the problem of students' struggles with developmental education. The challenges of developmental education are complex, and programs that have small impacts seem to be the norm. Previous experimental evaluations conducted by MDRC have shown that developmental math learning communities,[1] for instance, produced small, positive impacts on developmental math credits attempted and earned, but no impact on persistence or total credits earned.[2] In fact, after a few semesters, control group students had largely caught up with program group students.

Community colleges around the country continue to create and implement innovative strategies to improve student success in developmental math. Some, like MAPS, are interventions that take place completely outside the classroom,[3] while others change pedagogy, curriculum, or both. Many community colleges across the country have begun offering alternatives to the traditional lecture course, including courses based in computer labs using math module software and "flipped" courses in which students take a more active role in learning and presenting material in the classroom.[4] Two significant trends in developmental math curricular reform include accelerated courses, which shorten the timing or content of the courses so that students can get to college-level math more quickly, and modularized courses, which divide content into multiple separate modules, allowing students to speed through the material they already know so they can focus on the topics they don't. Case studies of accelerated and modularized courses indicate some positive outcomes, although they have not yet been rigorously tested.[5] MDRC has just begun a random assignment evaluation of a modularized ap-

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[1]In the learning community model, a cohort of students is coenrolled in two or more classes together, often with curricula and assignments that are thematically linked.

[2]Weissman et al. (2011).

[3]See, for example, the City University of New York's (CUNY's) Accelerated Study in Associate Programs for developmental students, described in Scrivener and Weiss (2013).

[4]Strayer (2012).

[5]Bragg and Barnett (2009); Zachry (2008).

proach called ModMath at Tarrant County Community College in Texas as a part of the Developmental Math Acceleration project, seeking to evaluate the efficacy of this model compared with typical college math courses.

A few proposals have taken more systemic approaches to changing developmental mathematics, considering classroom pedagogy, curriculum, supports to students, articulation, and course sequencing together. The idea is to improve the processes, strategies, and structures of developmental math instruction simultaneously. Notable approaches in this vein currently being piloted include CUNY Start, Statway/Quantway, and the New Mathways Project.[6]

At the state level, some proposals are taking on the developmental education challenge in completely new ways. In Florida, for example, the home of HCC, Senate Bill 1720 requires that recent high school graduates may bypass both placement testing and developmental classwork if they so choose. As of January 2014, all of these students may progress directly to college-level courses. The diploma or certificate is presumed to indicate college-ready status. High school juniors in Florida are now required to take an assessment test that determines college readiness in reading, writing, and math. If they are assessed to need remediation, they must address this during their senior year of high school. Older students are still required to take placement tests, and the Florida Community Colleges must provide these students with both intensive advising and a variety of developmental instructional types, including some mentioned above, such as co-requisite and modularized courses.

Other states, such as Texas, plan to revamp the developmental education system, recasting the placement tests students take and referring some students who might have previously required developmental education to instead take Adult Basic Education courses before beginning community college. Research into the effects and effectiveness of legislative strategies like these is warranted as more states are considering or have enacted similar approaches to developmental education.

Conclusion and Next Steps

Incentives and supports paired in a program like MAPS can be effective in improving rates of student success through a sequence of developmental mathematics courses. Although performance-based scholarships are not a complete solution to the developmental math question, this evaluation provides evidence that they can help low-income community college students'

[6]For more information on CUNY Start, see www.cuny.edu/academics/programs/notable/CATA/cti-cunystart.html. For more information on Statway/Quantway, see www.carnegiefoundation.org/statway. For more information on the New Mathways Project, see www.utdanacenter.org/higher-education/new-mathways-project. MDRC plans to evaluate the New Mathways Project in the coming years.

progress in math. While the study itself has ended, a small number of MAPS scholarships continue to be offered to students on all HCC campuses. HCC is hopeful that these scholarships can make a difference in students' academic success.

While the MAPS program is not as comprehensive as some of the developmental education overhauls discussed above, its impacts on student outcomes suggest that smaller, "outside of the classroom" programs can have a modest effect on students. For institutions unable to undertake significant overhauls, MAPS and interventions like it can be a first step or complement to other programs targeting developmental education students. The MAPS findings also suggest the potential power of requirements. In this study, the performance-based scholarship provided the incentive for students to enroll in math, visit Math Labs, and ultimately pass their math courses at higher rates. One question worth considering is whether some of these effects could be produced by requiring students to take their developmental courses early and consecutively, or requiring Math Lab attendance (or its equivalent), or both. Requiring students to take developmental courses immediately is a policy change that some institutions are beginning to test. It is unclear how effective these strategies would be without the performance-based scholarship as its financial benefits may extend beyond its motivational use; however, requirements coupled with an incentive program like MAPS to get students into tutoring or learning assistance centers may be an interesting variant of a performance-based scholarship.

A cross-site report on the PBS Demonstration will be published in 2015. This report will include longer-term follow-up for all sites, including HCC, and will look at patterns and impacts across sites to draw lessons from the larger demonstration. These findings will add to the growing body of knowledge about performance-based scholarship models and the efficacy of incentives for improving academic success among low-income students.

Appendix A

Selected Baseline Characteristics, by Research Group

The Performance-Based Scholarship Demonstration

Appendix Table A.1

Selected Baseline Characteristics, by Research Group

Hillsborough Community College

	Program Group		Control Group		Estimated Difference	
Characteristic	Mean	Standard Deviation	Mean	Standard Deviation	Mean	P-value
Gender (%)						
Male	34.6	47.6	32.2	46.8	2.4	0.4162
Female	65.4	47.6	67.8	46.8	-2.4	0.4162
Age (%)						
18-19 years old	24.0	42.8	22.2	41.6	1.9	0.4842
20-23 years old	23.1	42.2	24.5	43.0	-1.3	0.6236
24-26 years old	13.4	34.0	12.2	32.8	1.2	0.5850
27-30 years old	11.3	31.7	12.0	32.5	-0.7	0.7095
31 years and older	28.2	45.0	29.2	45.5	-1.0	0.7348
Average age (years)	27.1	9.3	26.8	8.6	0.2	0.6933
Race/ethnicity[a] (%)						
Hispanic	30.9	46.3	30.3	46.0	0.7	0.8136
White	32.1	46.7	27.9	44.8	4.2	0.1459
Black	30.5	46.1	37.6	48.5	-7.1 **	0.0179
Asian or Pacific Islander	1.7	12.8	0.5	7.1	1.2 *	0.0973
Other	4.8	21.4	3.8	19.1	1.0	0.4393
Married (%)	17.2	37.8	19.0	39.2	-1.8	0.4679
Missing	8.6	28.1	11.0	31.3	-2.4	0.1969
Number of children (%)						
0	57.3	49.5	54.2	49.9	3.0	0.3378
1	17.8	38.3	16.7	37.3	1.1	0.6474
2	12.1	32.6	13.1	33.8	-1.0	0.6192
3 or more	12.8	33.5	15.9	36.6	-3.1	0.1624

(continued)

Appendix Table A.1 (continued)

	Program Group		Control Group		Estimated Difference	
Characteristic	Mean	Standard Deviation	Mean	Standard Deviation	Mean	P-value
Among sample members with children						
Average age of youngest child (years)	*7.4*	*6.2*	*6.5*	*5.7*		
Disabilities or medical conditions[b] (%)						
General learning disability (dyslexia, etc.)	3.1	17.4	1.8	13.1	1.4	0.1770
Attention deficit/hyperactivity disorder, physical disability, or other	9.6	29.5	6.7	25.1	2.9	0.1001
None of the above	80.6	39.6	82.8	37.8	-2.2	0.3693
Missing	8.2	27.4	9.2	29.0	-1.1	0.5434
Household receiving any government benefits [c] (%)	37.7	48.5	38.5	48.7	-0.8	0.7912
Missing	12.5	33.1	12.7	33.4	-0.2	0.9073
Financial dependence[d] (%)						
Independent	59.2	49.2	63.1	48.3	-3.9	0.2037
Dependent	36.2	48.1	30.9	46.3	5.3 *	0.0765
Missing	4.6	21.0	6.0	23.8	-1.4	0.3184
Currently employed (%)	50.3	50.0	51.5	50.0	-1.1	0.7228
Among those currently employed						
Number of hours worked per week in current job (%)						
1-10 hours	*4.6*	*21.0*	*3.0*	*17.1*		
11-20 hours	*24.1*	*42.9*	*23.7*	*42.5*		
21-30 hours	*22.7*	*42.0*	*19.5*	*39.7*		
31-40 hours	*46.3*	*49.9*	*48.6*	*50.1*		
More than 40 hours	*2.3*	*14.5*	*5.2*	*22.9*		
Average hourly wage at current job ($)	*10*	*3*	*11*	*5*		
Highest grade completed (%)						
10th grade or lower	13.7	34.4	14.2	35.0	-0.6	0.8009
11th grade	9.0	28.6	7.0	25.5	2.0	0.2573
12th grade	77.4	41.9	78.8	40.9	-1.4	0.5891

(continued)

Appendix Table A.1 (continued)

Characteristic	Program Group Mean	Program Group Standard Deviation	Control Group Mean	Control Group Standard Deviation	Estimated Difference Mean	Estimated Difference P-value
Diplomas/degrees earned[b] (%)						
High school diploma	75.2	43.2	75.7	42.9	-0.5	0.8419
GED certificate	26.9	44.4	25.3	43.5	1.6	0.5597
Occupational/technical certificate	14.1	34.8	13.1	33.8	0.9	0.6698
Associate's degree or higher	1.4	11.5	1.3	11.2	0.1	0.8893
None of the above	0.1	3.9	0.0	0.0	0.1	0.4500
Date of high school graduation/GED receipt (%)						
During the past year	18.7	39.1	18.2	38.6	0.6	0.8154
Between 1 and 5 years ago	31.3	46.4	32.8	47.0	-1.4	0.6272
Between 5 and 10 years ago	19.1	39.3	18.6	39.0	0.4	0.8653
More than 10 years ago	30.9	46.2	30.4	46.1	0.4	0.8822
First semester at any college or university (%)	24.6	43.1	22.2	41.6	2.4	0.3721
Expected enrollment in coming semester (%)						
Full time (12 credits or more)	69.5	46.1	69.9	45.9	-0.4	0.8952
Part time (6 to 11 credits)	27.9	44.9	28.9	45.4	-0.9	0.7506
Less than part time (less than 6 credits)	2.6	15.9	1.3	11.2	1.3	0.1554
Main reason for enrolling in college[b] (%)						
To complete a certificate program	2.1	14.4	1.5	12.3	0.6	0.4924
To obtain an associate's degree	47.9	50.0	50.7	50.1	-2.7	0.3898
To transfer to a 4-year college/university	48.0	50.0	46.8	50.0	1.2	0.7069
To obtain/update job skills	3.3	18.0	1.8	13.3	1.5	0.1420
Other	0.8	8.7	1.0	10.1	-0.3	0.6456
First person in family to attend college (%)	33.4	47.2	33.1	47.1	0.3	0.9231

(continued)

Appendix Table A.1 (continued)

Characteristic	Program Group Mean	Program Group Standard Deviation	Control Group Mean	Control Group Standard Deviation	Estimated Difference Mean	Estimated Difference P-value
Highest degree/diploma earned by father (%)						
Not a high school graduate	18.5	38.9	20.0	40.0	-1.4	0.5663
High school diploma or GED certificate	31.7	46.6	32.4	46.9	-0.7	0.8191
Some college or associate's degree	14.1	34.8	15.2	36.0	-1.2	0.6026
Bachelor's degree or higher	11.4	31.8	5.2	22.3	6.2 ***	0.0007
Missing	24.2	42.9	27.1	44.5	-2.9	0.2876
Highest degree/diploma earned by mother (%)						
Not a high school graduate	16.8	37.4	14.7	35.5	2.1	0.3699
High school diploma or GED certificate	36.4	48.1	34.1	47.5	2.2	0.4605
Some college or associate's degree	23.9	42.7	28.2	45.0	-4.3	0.1156
Bachelor's degree or higher	11.4	31.8	10.5	30.7	0.9	0.6492
Missing	11.6	32.0	12.5	33.1	-0.9	0.6666
Language other than English spoken regularly in home (%)	26.4	44.1	24.3	43.0	2.1	0.4426
Sample size (total = 1,075)	674		401			

SOURCE: MDRC calculations from Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Characteristics shown in italics are nonexperimental. Significance tests are not conducted for nonexperimental data.

Missing values are included only in variable distributions for characteristics with more than 5 percent of the sample missing.

Distributions may not add to 100 percent because of rounding.

An omnibus f-test for joint significance was conducted for program and control groups. The test results were not significant at the 5 percent level, indicating that systematic differences between the program and control groups were not found.

[a]Respondents who said they are Hispanic and chose a race are included only in the Hispanic category. Respondents who said they are not Hispanic and chose more than one race are included in the Other category. These respondents, combined with those who said they were American Indian, Alaska Native, or another race/ethnicity, are included in Other.

[b]Distributions may not add to 100 percent because categories are not mutually exclusive.

[c]Benefits include unemployment/dislocated worker benefits, Supplemental Security Income or disability, cash assistance or welfare, food stamps, and Section 8 or public housing.

[d]Students were counted as financially independent if they met any of the following criteria as of random assignment: they were age 24 years or older, they were married, or they had one child or more.

Appendix B

Survey Response Analysis

This appendix discusses the student survey conducted as part of MDRC's evaluation of the Mathematics Access Performance Scholarship (MAPS) program. MDRC assessed the survey response rate and respondent characteristics to test the potential for bias in the result. This appendix also provides a supplementary survey table about students' employment and motivation.

Survey Fielding and Respondent Sample

The student survey for the performance-based scholarship program at Hillsborough Community College asked study participants about a variety of topics, including their educational experiences, math and Math Lab experiences, experiences with MAPS (for program group students only), self-confidence, motivation, work experiences, financial situation, and psychological well-being. The survey was fielded to the 1,075 sample members from March through May 2012,[1] during which time a total of 847 responses were collected. This was equivalent to an overall survey response rate of 79 percent.[2]

Characteristics of Survey Respondents

Two different analyses for potential bias in survey responses were conducted. First, baseline characteristics of survey respondents were compared with the characteristics of students who did not respond to the survey, which provides an indication of how representative the survey respondents are of the full study sample — in other words, a form of external validity. Second, baseline characteristics for program group students who responded to the survey were compared with characteristics for control group students who responded to the survey; this provides an indication of whether the results are internally valid for survey respondents.

Comparison of Respondent and Nonrespondent Characteristics

Appendix Table B.1 compares baseline characteristics for survey respondents and nonrespondents. The table indicates that respondents and nonrespondents were similar with regard

[1]Because the survey was fielded at the same time for all program cohorts, earlier cohorts had experienced more semesters of MAPS than later cohorts at the time of the fielding. In addition to the overall results presented here, survey results for each cohort were analyzed separately; results for individual cohorts were generally similar.

[2]Six students out of the study sample of 1,075 were excluded from the calculation of response rate. At the time of the survey fielding, these students were either deceased (1 student), away or unavailable to respond for the duration of the survey (4 students), or could not be contacted for other reasons (1 student). Excluding these 6 students, a total of 1,069 students remained. The 847 responses represent 79 percent of this group.

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Appendix Table B.1

Baseline Characteristics of Survey Respondents and Nonrespondents

Hillsborough Community College

Characteristic	Respondents	Non-respondents	Difference	Standard Error
Gender (%)				
Male	32.2	39.1	-6.9 *	3.5
Female	67.8	60.9	6.9 *	3.5
Age (%)				
18-19 years old	23.9	21.1	2.8	3.2
20-23 years old	22.4	28.2	-5.8 *	3.2
24-26 years old	12.3	15.4	-3.1	2.5
27-30 years old	11.9	10.3	1.6	2.4
31 years and older	29.5	25.0	4.5	3.4
Average age (years)	27.1	26.5	0.6	0.7
Race/ethnicity[a] (%)				
Hispanic	31.4	28.2	3.2	3.5
White	29.9	32.7	-2.8	3.4
Black	33.1	33.4	-0.3	3.6
Asian or Pacific Islander	1.3	0.9	0.5	0.8
Other	4.3	4.8	-0.5	1.6
Married (%)	18.6	15.0	3.6	2.9
Missing	9.6	9.0	0.7	2.2
Number of children (%)				
0	55.7	57.8	-2.2	3.7
1	16.6	20.3	-3.7	2.9
2	13.7	8.0	5.7 **	2.5
3 or more	14.0	13.8	0.2	2.6
Among sample members with children				
Average age of youngest child (years)	*7.2*	*6.5*		
Disabilities or medical conditions[b] (%)				
General learning disability (dyslexia, etc.)	2.6	2.6	0.0	1.2
Attention deficit/hyperactivity disorder, physical disability, or other	8.3	9.4	-1.1	2.1
None of the above	82.1	78.8	3.3	2.9
Missing	8.0	10.5	-2.5	2.1
Household receiving any government benefits[c] (%)	39.4	32.6	6.8 *	3.6
Missing	12.6	12.2	0.4	2.5

(continued)

Appendix Table B.1 (continued)

Characteristic	Respondents	Non-respondents	Difference	Standard Error
Financial dependence[d]				
Independent	60.9	59.9	1.0	3.7
Dependent	33.9	35.5	-1.6	3.6
Missing	5.3	4.6	0.6	1.7
Currently employed (%)	50.4	52.0	-1.6	3.8
Among those currently employed				
Number of hours worked per week in current job (%)				
1-10 hours	*4.2*	*3.4*		
11-20 hours	*22.8*	*28.1*		
21-30 hours	*21.2*	*22.4*		
31-40 hours	*47.8*	*44.7*		
More than 40 hours	*4.0*	*1.5*		
Average hourly wage at current job ($)	*10.3*	*10.5*		
Highest grade completed (%)				
10th grade or lower	12.6	18.5	-5.9 **	2.6
11th grade	8.7	6.5	2.2	2.1
12th grade	78.7	75.0	3.7	3.1
Diplomas/degrees earned[b] (%)				
High school diploma	76.1	72.7	3.4	3.2
GED certificate	25.5	29.0	-3.5	3.3
Occupational/technical certificate	13.1	16.1	-3.0	2.6
Associate's degree or higher	1.3	1.3	0.0	0.9
None of the above	0.1	0.0	0.1	0.2
Date of high school graduation/GED receipt (%)				
During the past year	18.7	18.0	0.7	3.0
Between 1 and 5 years ago	31.6	32.8	-1.2	3.6
Between 5 and 10 years ago	18.1	22.1	-4.0	3.0
More than 10 years ago	31.6	27.1	4.5	3.5
First semester at any college or university (%)	23.6	24.2	-0.7	3.2
Expected enrollment in coming semester (%)				
Full time (12 credits or more)	70.6	65.9	4.7	3.5
Part time (6 to 11 credits)	27.7	30.5	-2.8	3.4
Less than part time (less than 6 credits)	1.7	3.6	-1.9 *	1.1
Main reason for enrolling in college[b] (%)				
To complete a certificate program	1.9	1.9	0.0	1.0
To obtain an associate's degree	50.0	45.1	4.8	3.8
To transfer to a 4-year college/university	46.2	52.4	-6.1	3.8
To obtain/update job skills	3.0	1.8	1.2	1.2
Other	0.7	1.4	-0.7	0.7

(continued)

Appendix Table B.1 (continued)

Characteristic	Respondents	Non-respondents	Difference	Standard Error
First person in family to attend college (%)	33.6	32.0	1.6	3.6
Highest degree/diploma earned by father (%)				
Not a high school graduate	19.6	17.3	2.3	2.9
High school diploma or GED certificate	30.6	37.3	-6.7 *	3.5
Some college or associate's degree	15.0	12.7	2.3	2.6
Bachelor's degree or higher	10.1	5.6	4.5 **	2.2
Missing	24.8	27.2	-2.4	3.3
Highest degree/diploma earned by mother (%)				
Not a high school graduate	16.5	14.0	2.6	2.7
High school diploma or GED certificate	35.1	37.1	-2.0	3.6
Some college or associate's degree	25.5	25.3	0.2	3.3
Bachelor's degree or higher	11.1	10.9	0.2	2.3
Missing	11.7	12.7	-1.0	2.4
Language other than English spoken regularly in home (%)	27.5	18.6	8.9 ***	3.3
Sample size (total = 1,075)	847	228		

SOURCE: MDRC calculations from Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Characteristics shown in italics are nonexperimental. Significance tests are not conducted for nonexperimental data.

Missing values are only included in variable distributions for characteristics with more than 5 percent of the sample missing.

Distributions may not add to 100 percent because of rounding.

[a]Respondents who said they are Hispanic and chose a race are included only in the Hispanic category. Respondents who said they are not Hispanic and chose more than one race are included in the Other category. These respondents, combined with those who said they were American Indian, Alaska Native, or another race/ethnicity, are included in Other.

[b]Distributions may not add to 100 percent because categories are not mutually exclusive.

[c]Benefits include unemployment/dislocated worker benefits, Supplemental Security Income or disability, cash assistance or welfare, food stamps, and Section 8 or public housing.

[d]Students were counted as financially independent if they met any of the following criteria as of random assignment: they were age 24 years or older, they were married, or they had one child or more.

to most of the characteristics measured. However, several statistically significant differences were also found. Women were more likely to respond, with approximately 68 percent of respondents being women, compared with only 61 percent of nonrespondents. Individuals from households receiving government benefits were more likely to respond to the survey (39 percent of respondents compared with 33 percent of nonrespondents), while students whose highest completed high school grade was 10th grade or lower were less likely to respond (13 percent of respondents compared with 19 percent of nonrespondents.)

Students who planned to enroll less than part-time in the upcoming semester were less likely to respond (2 percent of respondents versus 4 percent of nonrespondents). Students with a father whose highest degree earned was a high school diploma or General Educational Development (GED) certificate were less likely to respond to the survey, while students whose father had earned a bachelor's degree or higher were more likely to respond the survey. Lastly, students who regularly spoke a language other than English at home were more likely to respond to the survey: 27.5 percent of respondents fell into this category, while only 19 percent of nonrespondents did.

An omnibus F-test was conducted to determine whether students' baseline characteristics were jointly predictive of responding to the survey.[3] The F-test yielded a p-value of 0.05, suggesting that respondents and nonrespondents differ in their baseline characteristics. This suggests that the survey results may not generalize to nonrespondents.

Comparison of Program and Control Group Respondent Characteristics

A slightly higher proportion of program group students responded to the survey (81 percent) compared with control group students (74 percent.) Appendix Table B.2 compares baseline characteristics for respondents in the program and control groups to determine whether respondents' characteristics differed between the two research groups. The table shows that the two groups were generally comparable, with survey respondents in the program group being slightly more likely to have one child (18 percent) than survey respondents in the control group (14 percent). Similarly, respondents in the program group were also more likely than respondents in the control group to have a father who had earned a bachelor's degree or higher: 12 percent of program group respondents met this criterion, while 6 percent of survey respondents in the control group did. Given how many baseline variables were explored, seeing a few modest differences in baseline characteristics is not unexpected.

An omnibus F-test was conducted to determine whether survey respondents' baseline characteristics were jointly predictive of student's experimental status. The results were not statistically significant, indicating little evidence that the groups of respondents were systematically different at the outset of the study.

Appendix Table B.3 compares program and control group members' employment status and motivation to complete their coursework, as discussed in Chapter 3.

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[3]Logistic regression was used for this analysis, where the outcome was whether a sample member responded to the survey and the predictor variables were students' baseline characteristics.

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Appendix Table B.2

Baseline Characteristics of Survey Respondents, by Research Group

Hillsborough Community College

Characteristic	Program Group	Control Group	Difference	Standard Error
Gender (%)				
Male	32.6	31.5	1.1	3.4
Female	67.4	68.5	-1.1	3.4
Age (%)				
18-19 years old	24.0	23.8	0.2	3.1
20-23 years old	22.4	22.2	0.2	3.0
24-26 years old	12.8	11.4	1.4	2.4
27-30 years old	11.6	12.5	-0.8	2.3
31 years and older	29.2	30.1	-1.0	3.3
Average age (years)	27.2	27.0	0.2	0.7
Race/ethnicity[a] (%)				
Hispanic	30.7	32.7	-2.0	3.4
White	31.1	27.2	3.9	3.3
Black	31.5	36.4	-4.9	3.4
Asian or Pacific Islander	1.9	0.3	1.5 *	0.8
Other	4.8	3.4	1.4	1.5
Married (%)	19.1	17.8	1.4	2.8
Missing	9.3	10.1	-0.8	2.1
Number of children (%)				
0	55.8	55.4	0.4	3.6
1	18.2	13.7	4.5 *	2.7
2	13.0	14.9	-1.9	2.5
3 or more	13.0	16.0	-3.0	2.5
Among sample members with children				
Average age of youngest child (years)	*7.4*	*6.7*		
Disabilities or medical conditions[b] (%)				
General learning disability (dyslexia, etc.)	3.3	1.4	1.9 *	1.1
Attention deficit/hyperactivity disorder, physical disability, or other	9.1	6.7	2.4	2.0
None of the above	81.2	83.9	-2.7	2.8
Missing	8.0	8.0	0.0	2.0
Household receiving any government benefits [c] (%)	39.1	40.0	-0.9	3.5
Missing	12.6	12.7	-0.1	2.4

(continued)

Appendix Table B.2 (continued)

Characteristic	Program Group	Control Group	Difference	Standard Error
Financial dependence[d]				
Independent	60.5	61.7	-1.2	3.5
Dependent	34.8	32.2	2.6	3.4
Missing	4.7	6.0	-1.3	1.6
Currently employed (%)	49.9	51.3	-1.4	3.6
Among those currently employed				
Number of hours worked per week in current job (%)				
1-10 hours	*4.6*	*3.4*		
11-20 hours	*23.9*	*20.4*		
21-30 hours	*22.5*	*18.7*		
31-40 hours	*46.2*	*51.0*		
More than 40 hours	*2.8*	*6.5*		
Average hourly wage at current job ($)	*10.1*	*10.7*		
Highest grade completed (%)				
10th grade or lower	12.9	12.2	0.7	2.4
11th grade	9.2	7.9	1.2	2.1
12th grade	77.9	79.9	-2.0	3.0
Diplomas/degrees earned[b] (%)				
High school diploma	75.4	77.2	-1.8	3.1
GED certificate	26.6	23.8	2.8	3.2
Occupational/technical certificate	13.4	12.6	0.8	2.4
Associate's degree or higher	1.3	1.4	-0.1	0.8
None of the above	0.2	0.0	0.2	0.2
Date of high school graduation/GED receipt (%)				
During the past year	18.4	19.6	-1.2	2.8
Between 1 and 5 years ago	30.6	32.9	-2.3	3.4
Between 5 and 10 years ago	18.9	16.4	2.5	2.8
More than 10 years ago	32.1	31.1	1.0	3.4
First semester at any college or university (%)	24.7	22.0	2.7	3.0
Expected enrollment in coming semester (%)				
Full time (12 credits or more)	70.5	71.2	-0.7	3.3
Part time (6 to 11 credits)	27.5	27.8	-0.3	3.3
Less than part time (less than 6 credits)	2.1	1.0	1.0	0.9
Main reason for enrolling in college[b] (%)				
To complete a certificate program	2.2	1.4	0.9	1.0
To obtain an associate's degree	48.9	51.7	-2.8	3.6
To transfer to a 4-year college/university	46.5	45.9	0.6	3.6
To obtain/update job skills	3.5	2.0	1.5	1.2
Other	0.6	1.0	-0.5	0.6

(continued)

Appendix Table B.2 (continued)

Characteristic	Program Group	Control Group	Difference	Standard Error
First person in family to attend college (%)	33.3	34.3	-0.9	3.5
Highest degree/diploma earned by father (%)				
Not a high school graduate	18.6	21.5	-2.9	2.9
High school diploma or GED certificate	30.2	31.2	-1.0	3.3
Some college or associate's degree	14.7	15.5	-0.7	2.6
Bachelor's degree or higher	12.4	5.7	6.7 ***	2.2
Missing	24.1	26.2	-2.1	3.1
Highest degree/diploma earned by mother (%)				
Not a high school graduate	17.1	15.4	1.7	2.7
High school diploma or GED certificate	35.2	35.2	-0.1	3.4
Some college or associate's degree	24.6	27.2	-2.6	3.1
Bachelor's degree or higher	11.5	10.4	1.0	2.3
Missing	11.7	11.8	-0.1	2.3
Language other than English spoken regularly in home (%)	28.2	26.5	1.7	3.2
Sample size (total = 847)	549	298		

SOURCE: MDRC calculations from Baseline Information Form data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Characteristics shown in italics are nonexperimental. Significance tests are not conducted for nonexperimental data.

Missing values are included only in variable distributions for characteristics with more than 5 percent of the sample missing.

Distributions may not add to 100 percent because of rounding.

[a]Respondents who said they are Hispanic and chose a race are included only in the Hispanic category. Respondents who said they are not Hispanic and chose more than one race are included in the Other category. These respondents, combined with those who said they were American Indian, Alaska Native, or another race/ethnicity, are included in Other.

[b]Distributions may not add to 100 percent because categories are not mutually exclusive.

[c]Benefits include unemployment/dislocated worker benefits, Supplemental Security Income or disability, cash assistance or welfare, food stamps, and Section 8 or public housing.

[d]Students were counted as financially independent if they met any of the following criteria as of random assignment: they were age 24 years or older, they were married, or they had one child or more.

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Appendix Table B.3

Student Employment and Motivation

Hillsborough Community College

Outcome	Program Group	Control Group	Difference	Standard Error
Employment				
Currently working for pay or profit (%)	71.3	71.7	-0.4	3.0
Number of hours usually worked per week	22.9	23.1	-0.3	1.2
Identify as being "financially stressed" (%)				
Strongly agree	37.9	37.5	0.4	3.6
Agree	37.2	35.8	1.4	3.6
Disagree	18.9	20.3	-1.3	2.9
Strongly disagree	6.0	6.5	-0.5	1.8
Motivation				
Motivation to complete coursework (average)				
Relative autonomy index[a]	4.1	3.8	0.3	0.3
Sample size (total = 847)	549	298		

SOURCE: MDRC calculations using responses from the Performance-Based Scholarship Hillsborough Community College survey.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Missing values are not included in individual variable distributions.

[a]The Relative Autonomy Index (RAI) has a possible range of -18 to 18, where a higher value represents greater autonomous motivation. The RAI is calculated as a weighted average: RAI = [External × (-2)] + [Introjected × (-1)] + [Identified × (1)] + [Integrated × (2)].

Appendix C

Impact Tables

The Performance-Based Scholarship Demonstration

Appendix Table C.1

Credits Attempted and Earned (Cumulative)

Hillsborough Community College

	Program Group		Control Group		Estimated Effects	
Outcome	Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference	P-value
First semester						
Total credits attempted	10.7	3.8	10.5	4.0	0.3	0.1923
Math	3.7	1.0	3.3	1.5	0.4 ***	0.0000
Non-math	7.0	3.4	7.1	3.4	-0.1	0.4481
Total credits earned	7.5	4.7	6.8	4.6	0.7 **	0.0129
Math	2.3	2.0	1.8	2.0	0.4 ***	0.0010
Non-math	5.3	3.7	5.0	3.6	0.3	0.1733
First year						
Total credits attempted	21.6	9.5	20.7	9.2	0.9	0.1021
Math	6.8	2.6	5.9	2.7	0.9 ***	0.0000
Non-math	14.8	7.9	14.8	7.8	0.0	0.9517
Total credits earned	15.0	10.5	13.7	10.0	1.3 **	0.0451
Math	4.1	3.4	3.5	3.3	0.7 ***	0.0012
Non-math	10.9	8.3	10.3	8.0	0.6	0.2280
First year and one semester						
Total credits attempted	27.6	13.5	26.3	13.0	1.4 *	0.0926
Math	8.4	3.4	7.3	3.6	1.1 ***	0.0000
Non-math	19.3	11.2	19.0	10.8	0.3	0.6790
Total credits earned	19.2	14.3	17.6	13.6	1.5 *	0.0845
Math	5.0	4.2	4.3	4.0	0.8 ***	0.0038
Non-math	14.1	11.4	13.4	10.9	0.8	0.2686
First two years						
Total credits attempted	33.2	18.2	31.6	17.5	1.7	0.1367
Math	9.5	4.4	8.5	4.6	1.0 ***	0.0003
Non-math	23.7	15.0	23.1	14.3	0.6	0.4994
Total credits earned	23.1	18.1	21.5	17.6	1.6	0.1603
Math	5.6	4.7	4.9	4.7	0.7 **	0.0137
Non-math	17.5	14.7	16.6	14.3	0.9	0.3463
Sample size (total = 1,075)	674		401			

SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

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Appendix Table C.2

Credits Attempted and Earned (Noncumulative)

Hillsborough Community College

	Program Group		Control Group		Estimated Effects	
Outcome	Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference	P-value
First semester						
Enrolled (%)	95.8	20.3	93.9	23.8	1.9	0.1702
Total credits attempted	11.8	4.8	11.5	5.1	0.3	0.2708
Math	4.1	1.5	3.6	1.8	0.5 ***	0.0000
Non-math	7.7	4.0	7.9	4.3	-0.2	0.3715
Total credits earned	8.3	5.6	7.7	5.8	0.6 *	0.0747
Math	2.5	2.3	2.1	2.2	0.5 ***	0.0015
Non-math	5.8	4.3	5.6	4.5	0.2	0.5445
Second semester						
Enrolled (%)	79.5	40.4	78.1	41.4	1.3	0.6046
Total credits attempted	9.8	7.0	9.2	6.5	0.6	0.1299
Math	2.7	2.1	2.3	2.0	0.4 ***	0.0017
Non-math	7.1	5.7	6.9	5.4	0.2	0.5124
Total credits earned	6.8	6.5	6.2	6.2	0.6	0.1088
Math	1.6	2.0	1.4	2.0	0.2 *	0.0559
Non-math	5.2	5.3	4.8	5.1	0.4	0.2170
Third semester						
Enrolled (%)	60.2	49.1	57.9	49.3	2.4	0.4481
Total credits attempted	6.5	6.3	6.1	6.0	0.4	0.2791
Math	1.6	1.8	1.5	1.7	0.2	0.1398
Non-math	4.9	5.2	4.6	4.9	0.3	0.4288
Total credits earned	4.6	5.5	4.4	5.3	0.2	0.5381
Math	1.0	1.6	0.9	1.5	0.1	0.3558
Non-math	3.6	4.7	3.5	4.4	0.1	0.6779

(continued)

Appendix Table C.2 (continued)

	Program Group		Control Group		Estimated Effects	
Outcome	Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference	P-value
Fourth semester						
Enrolled (%)	49.6	50.0	46.8	50.0	2.8	0.3726
Total credits attempted	5.1	6.1	4.8	6.0	0.3	0.4045
Math	1.1	1.7	1.1	1.8	0.0	0.9468
Non-math	4.0	5.2	3.7	4.9	0.3	0.3088
Total credits earned	3.8	5.2	3.7	5.1	0.1	0.6730
Math	0.6	1.3	0.6	1.4	0.0	0.9372
Non-math	3.2	4.6	3.1	4.4	0.1	0.6088
Sample size (total = 1,075)	674		401			

SOURCE: MDRC calculations from Hillsborough Community College transcript data.

NOTES: Rounding may cause slight discrepancies in sums and differences. Estimates are adjusted by cohort-campus interaction, National Center for Education Statistics risk factors, and selected pre-random assignment placement test scores.

A two-tailed t-test was applied to differences between research groups. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; * = 10 percent.

Note that spring and summer semesters are combined in the semesters shown here; see Figure 3.1 for more information.

Appendix D

Key Cost Terms

The following terms are used in the cost analysis, presented in Chapter 5, of the Mathematics Access Performance Scholarship (MAPS) program at Hillsborough Community College as part of the Performance-Based Scholarship Demonstration.

Direct cost: the cost directly associated with providing performance-based scholarships and the program's components.

Base cost: the cost of the usual college services in the absence of the program. *Base cost = cost per credit* x *number of credits attempted by the control group*. The *cost per credit* is an estimate of the average amount of resources expended by the college to provide one credit's worth of instructional activity; it is calculated by dividing the college's annual operating budget by the number of credits attempted at the college during the year of interest.

Indirect cost: the cost resulting from a behavioral change brought about by the program, such as additional credits attempted by program group members; such costs can extend beyond the period of program operation. *Indirect cost of the program = cost per credit* x *additional credits attempted by program group members*.

Program group cost: the total cost of educating program group members over two years of follow-up. *Program group cost = base cost + direct cost + indirect cost. Program group cost* can be divided by the number of program group members to get the *cost per program group member*.

Control group cost: the total cost of educating control group members over two years of follow-up. *Control group cost = base cost. Control group cost* can be divided by the number of control group members to get the *cost per control group member*.

Net cost: the cost difference between program group members and control group members. *Net cost = program group cost – control group cost*.

Cost-effectiveness analysis: an evaluation in which the net costs of alternative interventions are expressed as the cost per unit of a desired outcome. In this analysis, cost-effectiveness is presented for *cost per college-level math completion, cost per math credit earned,* and *cost per total credit earned.*

Cost per college-level math completion: the amount invested in the research group of interest per college-level math completion by that research group. For the program group, *cost per college-level math completion = program group cost ÷ number of college-level math completions by program group members.*

Cost per math credit earned: the amount invested in the research group of interest per math credit earned by that research group. For the program group, *cost per math credit earned = program group cost ÷ number of math credits earned by program group members.*

Cost per total credits earned: the amount invested in the research group of interest per total credit earned by that research group. For the program group, *cost per total credits earned = program group cost ÷ number of total credits earned by the program group members.*

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Founded in 1974 and located in New York City and Oakland, California, MDRC is best known for mounting rigorous, large-scale, real-world tests of new and existing policies and programs. Its projects are a mix of demonstrations (field tests of promising new program approaches) and evaluations of ongoing government and community initiatives. MDRC's staff bring an unusual combination of research and organizational experience to their work, providing expertise on the latest in qualitative and quantitative methods and on program design, development, implementation, and management. MDRC seeks to learn not just whether a program is effective but also how and why the program's effects occur. In addition, it tries to place each project's findings in the broader context of related research — in order to build knowledge about what works across the social and education policy fields. MDRC's findings, lessons, and best practices are proactively shared with a broad audience in the policy and practitioner community as well as with the general public and the media.

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- Promoting Family Well-Being and Children's Development
- Improving Public Education
- Raising Academic Achievement and Persistence in College
- Supporting Low-Wage Workers and Communities
- Overcoming Barriers to Employment

Working in almost every state, all of the nation's largest cities, and Canada and the United Kingdom, MDRC conducts its projects in partnership with national, state, and local governments, public school systems, community organizations, and numerous private philanthropies.