

# Laying the Foundations

Early Findings from the  
New Mathways Project

Elizabeth Zachry Rutschow  
John Diamond

April 2015



# **Laying the Foundations: Early Findings from the New Mathways Project**

**Elizabeth Zachry Rutschow**

**John Diamond**

**with**

**Elena Serna-Wallender**

**April 2015**



Funding for this report was provided by the Charles A. Dana Center at the University of Texas-Austin and the Lumina Foundation.

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

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

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

For information about MDRC and copies of our publications, see our website: [www.mdrc.org](http://www.mdrc.org).

Copyright © 2015 by MDRC®. All rights reserved.

## Overview

National studies reveal that 50 percent to 70 percent of community college students are required to take developmental, or remedial, math courses upon enrollment, and only 20 percent of developmental math students ever successfully complete a college-level math course. Recent reforms have sought to improve students' success rate by revising developmental math *course structure* and *sequence* into compressed instructional modules or multiweek (rather than semester-long) courses, or by placing developmental students into college-level classes with added supports. Though these initiatives have shown some promise, they have seldom addressed the *math content* of developmental and college-level math courses, which emphasize algebra rather than the quantitative literacy and statistics skills required in most of today's professions.

Taking up the challenge in all three areas is the New Mathways Project (NMP), developed by the Charles A. Dana Center at the University of Texas at Austin in partnership with the Texas Association of Community Colleges. This new initiative aims to change the standard pathways to and through colleges' traditional math sequences. Key to the work is the implementation of differentiated math course sequences that are closely aligned with the requirements of different academic and eventual career paths: a *Statistical Reasoning* pathway, appropriate for students in social sciences careers, such as allied health, government, or psychology; a *Quantitative Reasoning* pathway for students in humanities or general liberal arts fields; and a *Science, Technology, Engineering, and Mathematics (STEM-Prep)* pathway for students pursuing careers that require strong algebraic skills, such as chemistry, computer science, or engineering. The Dana Center is supporting implementation at the institutional level through tools, resources, and services focused on planning, staff training, curricula, and instruction. And because these reforms have important consequences for students' ability to transfer credits to four-year colleges and universities, the Dana Center is working at the state level to identify and address key policy obstacles such as the course requirements for different majors in four-year institutions.

This report analyzes the development of the NMP from spring 2012 through its first year of rollout at nine colleges in Texas in 2013-2014, as well as student outcomes at the colleges before and during the first year. Overall, this study found that the Dana Center made significant progress in laying the groundwork for the implementation of multiple math pathways in Texas, helping foment change in how two-year and four-year colleges view students' math requirements. To be sure, the Dana Center has work to do to reach its ambitious goals to scale up the initiative, as colleges met with obstacles around student recruitment, faculty reservations about course content, and the applicability of the pathways for students transferring to four-year colleges. Yet as of fall 2014, 20 Texas community college systems were offering at least one NMP course,<sup>1</sup> and descriptive outcome data reveal promising results in NMP students' developmental and college-level course completion, with 30 percent of students completing both courses in the first year.

---

<sup>1</sup>In multi-institution systems, generally only one or two campuses were implementing an NMP pathway.



# Contents

<b>Overview</b>	iii
<b>List of Exhibits</b>	vii
<b>Preface</b>	ix
<b>Acknowledgments</b>	xi
<b>Executive Summary</b>	ES-1

## Chapter

<b>1 Introduction</b>	1
The Challenges with Developmental and College-Level Math	3
The New Mathways Project: Designing Multiple Math Pathways	5
Developing for Scale: Planning for Statewide Implementation	9
Research on the NMP	12
Structure of the Report	13
<b>2 Preparing for Implementation of the NMP: Spring and Summer 2013</b>	15
Signing on to the NMP: The Nine Codevelopment Colleges	16
Training and Support for Implementation	17
Faculty Understanding and Leadership of the NMP	21
Bringing Students In: Recruitment for the NMP Courses	23
Summary	26
<b>3 Initial Implementation of the NMP Courses</b>	27
Building It from the Ground Up: The Codevelopment Colleges' Implementation of Foundations and Frameworks	28
Spring 2014: Implementation of the Statistical Reasoning Course	36
Summary	40
<b>4 Student Developmental Math Outcomes</b>	41
Mirroring the Nation: A Picture of Remedial Need in Texas Community Colleges	42
Developmental Math Progress at the NMP Codevelopment Colleges	44
Student Success in NMP and non-NMP Courses: Developmental and College-Level Math Outcomes in 2013-2014	45
Summary	50

<b>5 Moving Beyond the Institution:</b>	
<b>Implications for Policy and Practice from a Statewide Perspective</b>	53
Scaling the NMP: Overcoming Critical Challenges to Implementation	55
Summary	59
<b>Appendix</b>	
<b>A College Systems Implementing the NMP</b>	61
<b>References</b>	65



# List of Exhibits

## Table

ES.1	Math Outcomes Among Students Enrolled in NMP Foundations at Codevelopment Colleges, Fall 2013 Through Spring 2014	ES-10
2.1	Fall 2013 Student Population at Codevelopment Colleges	18
2.2	Enrollment in NMP Courses at Codevelopment Colleges, Fall 2013 Through Spring 2014	24
4.1	Fall 2009 Cohort Developmental Math Needs and Progress at Texas Community Colleges	44
4.2	Developmental Math Enrollment and Pass Rates at Codevelopment Colleges, Fall 2011 Through Spring 2014	45
4.3	Math Outcomes Among Students Enrolled in Traditional Developmental Math Courses at Codevelopment Colleges, Fall 2013 Through Spring 2014	48
4.4	Math Outcomes Among Students Enrolled in NMP Foundations at Codevelopment Colleges, Fall 2013 Through Spring 2014	49
A.1	List of College Systems Implementing the NMP	63

## Figure

ES.1	A Comparison of Mathematics Offerings for Students with Two Levels of Developmental Need	ES-5
1.1	A Comparison of Mathematics Offerings for Students with Two Levels of Developmental Need	7
1.2	Texas Community College Systems Implementing the NMP	11

## Box

3.1	A Sample Foundations Lesson: Measuring Blood Alcohol Content	30
3.2	A Sample Frameworks Lesson: The Plastic Brain and Smart Thinking	31
3.3	A Sample Statistical Reasoning Lesson: Designing Experiments	37



## Preface

Math remains a significant stumbling block to many college students' success, particularly among those who arrive with lower-level skills. More than half our nation's community college students are assessed as needing at least one developmental, or remedial, math course, and these students often have to take two or more semesters of preparatory courses before being allowed entry into a college-level math class. Sadly, few ever succeed in achieving this goal: It is estimated that only 20 percent of students in need of two or more developmental courses complete a college-level course within three years.

As these students continue to stumble, there has been a growing awareness that the types of math skills required in many of today's professions differ from those taught in traditional college math courses. Most college math courses are focused on discrete algebra skills — for example, factoring and polynomial equations — which provide good preparation for higher-level mathematics courses, such as calculus. However, employers in fields as varied as criminal justice, nursing, and journalism are more often seeking candidates who have strong quantitative reasoning and statistical skills. Indeed, recent research has shown that only about 5 percent of today's professions use the higher-level skills taught in most college algebra courses.

Reforms such as the New Mathways Project (NMP), which attempt to revise the content of college math courses to align with the needs of today's marketplace, represent a promising step forward in the nation's efforts to improve the odds of community college students' success. By increasing the relevance of math content within both developmental and college-level courses, the NMP seeks to better engage students in their math learning — while also accelerating their progress through developmental courses. And with its focus on implementation at all 50 community college systems in Texas and detailed attention given to the state-level and cross-institution policies that can support this change, the NMP represents an ambitious departure from the more isolated reforms being undertaken by individual community colleges.

Given its ambition, it is not surprising that the NMP has met with some substantial challenges in implementation, including the coordination of math requirements across two-year and four-year institutions and math faculty members' reluctance to move away from algebra-based content. The field can learn much from these efforts to push developmental education reform beyond the realm of single institutions to a larger state and national playing field — as well as from the efforts to improve community college students' achievement.

Gordon L. Berlin  
President, MDRC



## Acknowledgments

We are grateful for the support provided by the Charles A. Dana Center at the University of Texas-Austin and the Lumina Foundation, which provided funding to enable the development of this document. In addition, we greatly appreciate the input from the nine colleges that participated in the New Mathways Project that made this report possible: Austin Community College, Brazosport College, El Paso Community College, Kilgore College, Lone Star College-Kingwood, Midland College, Alamo Colleges District-Northwest Vista, South Texas College, and Temple College.

We are also thankful to the many individuals who read and reviewed this report. In particular, we are grateful to those who gave us excellent written and oral feedback, including Gordon Berlin, Robert Ivry, Alexander Mayer, Lashawn Richburg-Hayes, Susan Scrivener, Alice Tufel, and Evan Weissman of MDRC, and Jenna Cullinane, Jennifer Dorsey, Amy Getz, Monette McIver, and Simon Tidd at the Charles A. Dana Center at the University of Texas at Austin. Finally, we would like to thank the publications staff at MDRC, including Jennie Kaufman, who edited the report, and Stephanie Cowell, who prepared it for publication.

The Authors



## Executive Summary

*When I started back to school last semester for the first time in a long time, I had [to take] five math classes [to complete the requirements for my major], and ... I was stuck in 0308 [remedial algebra]. ... I failed it the third time with a 62. So every time it was improving — [but] it just wasn't getting me anywhere. — Jenny, Spring 2014, student at a college implementing the New Mathways Project courses*

Recent research on developmental education has shown that students like Jenny are the norm at community colleges. National studies reveal that 50 percent to 70 percent of community college students enter school each year unprepared for college-level math and must take a series of developmental, or remedial, courses to build their skills before they can enroll in a college-level math course.<sup>1</sup> Sadly, most of these students also experience Jenny's failure: Only one-third of the students referred to these remedial courses ever complete them, and just one-fifth enter and successfully complete a college-level math course within three years.<sup>2</sup> The past few years have seen some efforts to reform this system, primarily by shortening the developmental math *course structure* and *sequence* by compressing instruction into modules or multiweek courses, or by placing developmental students into college-level classes with added supports.<sup>3</sup> Though these initiatives have shown some promise for improving students' progress through developmental education,<sup>4</sup> they have generally not addressed another issue that some have argued is critical for

---

<sup>1</sup>Thomas Bailey, Dong Wook Jeong, and Sung-Woo Cho, "Referral, Enrollment, and Completion in Developmental Education Sequences in Community Colleges," *Achieving the Dream: Community Colleges Count Initiative Paper* (Community College Research Center, 2009); Radha Roy Biswas, "Accelerating Remedial Math Education: How Institutional Innovation and State Policy Interact," *Achieving the Dream Policy Brief* (Boston: Jobs for the Future, 2007); Texas Higher Education Coordinating Board, "Developmental Education Accountability Measures Data," accessed January 30, 2015, [http://www.txhighereddata.org/reports/performance/deved/inst.cfm?inst=778888&report\\_type=2&report\\_yr=2013](http://www.txhighereddata.org/reports/performance/deved/inst.cfm?inst=778888&report_type=2&report_yr=2013).

<sup>2</sup>Bailey, Jeong, and Cho (2009); Elizabeth Zachry Rutschow and Emily Schneider, *Unlocking the Gate: What We Know About Improving Developmental Education* (New York: MDRC, 2011).

<sup>3</sup>Kelley Fong and Mary Visser, *Fast Forward: A Case Study of Two Community College Programs Designed to Accelerate Students Through Developmental Math* (New York: MDRC, 2013); Peter Adams, Sarah Gearhart, Robert Miller, and Anne Roberts, "The Accelerated Learning Program: Throwing Open the Gates," *Journal of Basic Writing (CUNY)* 28, 2 (2009): 50-69; Shanna S. Jaggars, Nikki Edgecombe, and Georgia W. Stacey, *What We Know About Accelerated Developmental Education* (New York: Community College Research Center, Teachers College, Columbia University, 2014); Zachry Rutschow and Schneider (2011); Paul Fain, "How to End Remediation," *Inside Higher Ed* (April 4, 2012), <http://www.insidehighered.com>; Paul Fain, "Remediation If You Want It," *Inside Higher Ed* (June 5, 2013), <https://www.insidehighered.com>; Elisabeth A. Barnett, Rachel Hare Bork, Alexander K. Mayer, Joshua Pretlow, Heather D. Wathington, and Madeline Joy Weiss, *Bridging the Gap: An Impact Study of Eight Developmental Summer Bridge Programs in Texas* (New York: National Center for Postsecondary Research, 2012).

<sup>4</sup>Zachry Rutschow and Schneider (2011); Fong and Visser (2013).

students' success: the type of *math content* taught in developmental and college-level math courses. Recent research has shown that few professions (5 percent) require the higher-level algebra and calculus skills that most college algebra courses teach. Instead, most professions tend to rely on basic quantitative literacy and statistics skills, such as the ability to manipulate fractions and percentages, solve multistep word problems, and comprehend written statistical charts and graphs.<sup>5</sup>

Galvanized by this information, Uri Treisman and the Charles A. Dana Center at the University of Texas at Austin, an organization focused on mathematics and science reform in both K-12 and postsecondary institutions, concentrated on rethinking this math challenge. Building on their alliance with the Carnegie Foundation for the Advancement of Teaching (2009-2011) in creating Statway and Quantway,<sup>6</sup> the Dana Center launched the New Mathways Project (NMP) in collaboration with the Texas Association of Community Colleges in spring 2012. The NMP is a new initiative aimed at changing the standard pathways to and through colleges' traditional math sequences. Key to the work is the implementation of accelerated, non-algebra-intensive math pathways that are more aligned with the needs of social sciences, health, and liberal arts professions, as well as the development of a revised model for the algebra pathway for students in science, technology, engineering, and math (STEM) careers. The Dana Center also works at the state level to leverage the collective power of the Texas community colleges to identify and address policy obstacles.

This report analyzes the development of the New Mathways Project from spring 2012 through its first year of implementation at nine colleges in Texas in 2013-2014, as well as student outcomes at the colleges before and during NMP implementation. Overall, this study found that the Dana Center made significant progress in laying the groundwork for the implementation of multiple math pathways in Texas, helping foment a change in how two-year and four-year colleges viewed students' math requirements. Faculty, staff, and administrators were supportive of the move toward multiple math pathways, and students consistently noted improvements in their ability to understand and do math. Colleges did meet obstacles, particularly around student recruitment, faculty reservations with the curricular materials, and the alignment of two-year

---

<sup>5</sup>Michael J. Handel, "What Do People Do At Work? A Profile of U.S. Jobs from the Survey of Workplace Skills, Technology, and Management Practices (STAMP)" (unpublished paper, Northeastern University, Boston, 2010); John Philip Smith, "Tracking the Mathematics of Automobile Production: Are Schools Failing to Prepare Students for Work?" *American Education Research Journal* 34, 4 (1999): 835-878; Celia Hoyles, Richard Noss, and Stefano Pozzi, "Proportional Reasoning in Nursing Practice," *Journal for Research in Mathematics Education* 32, 1 (2001): 4-27.

<sup>6</sup>Statway and Quantway are two alternative, yearlong developmental and college-level math pathways based on statistics and quantitative reasoning. They are now part of the Carnegie Foundation for the Advancement of Teaching's Pathways Improvement Communities and have been or are currently being implemented by 49 institutions across the country.



and four-year colleges' course policies during the 2013-2014 academic year. But five of the first colleges to participate expanded their NMP offerings in spring and fall 2014, and as of fall 2014, 20 Texas community college systems were offering at least one NMP course. Descriptive outcome data revealed promising results in the NMP students' developmental and college-level course completion, with 30 percent of NMP students completing a college-level math course in the first year, in contrast to only 8.3 percent of students enrolled in traditional developmental education classes during the same period.<sup>7</sup>

## The New Mathways Project Design

In 2012, the Dana Center became focused on creating and implementing a set of math pathways that would revise the *structure*, *sequencing*, and *content* of developmental and college-level math courses in Texas. The NMP model aims to help colleges adopt four key principles:<sup>8</sup>

1. **Multiple math pathways with relevant and challenging content aligned to specific fields of study.** Colleges should offer at least two math pathways, beginning at the developmental level, for students to complete their program-specific, college-level math requirements. At least one math pathway should be non-algebra intensive and focused on the statistical and quantitative reasoning skills needed in many current professions.
2. **Acceleration that allows students to complete a college-level math course more quickly than they would in the traditional developmental and college-level math sequence.** The NMP focuses on shortening the developmental math course trajectory to allow students to reach and complete a college-credit math course in one year or less.
3. **Intentional use of strategies to help students develop skills as learners.** Colleges should integrate learning theory and skills within math courses and link these skills with a student success course and related activities and services.<sup>9</sup>

---

<sup>7</sup>Students in traditional developmental education courses include students who require one, two, or three developmental math courses, while NMP courses are targeted to students in need of one or two developmental courses.

<sup>8</sup>Charles A. Dana Center, *The New Mathways Project Implementation Guide*, in collaboration with the Texas Association of Community Colleges (Austin: The University of Texas at Austin, 2014), website: <http://www.utdanacenter.org>.

<sup>9</sup>Charles A. Dana Center, "Frameworks for Mathematics and Collegiate Learning," version 2.0 (Austin: The University of Texas at Austin, 2014), <http://www.utdanacenter.org>.

4. **Curricular design and pedagogy based on proven practice.** Math curricula and pedagogy should center on evidence-based instructional and content practices and be continuously improved as new evidence becomes available.

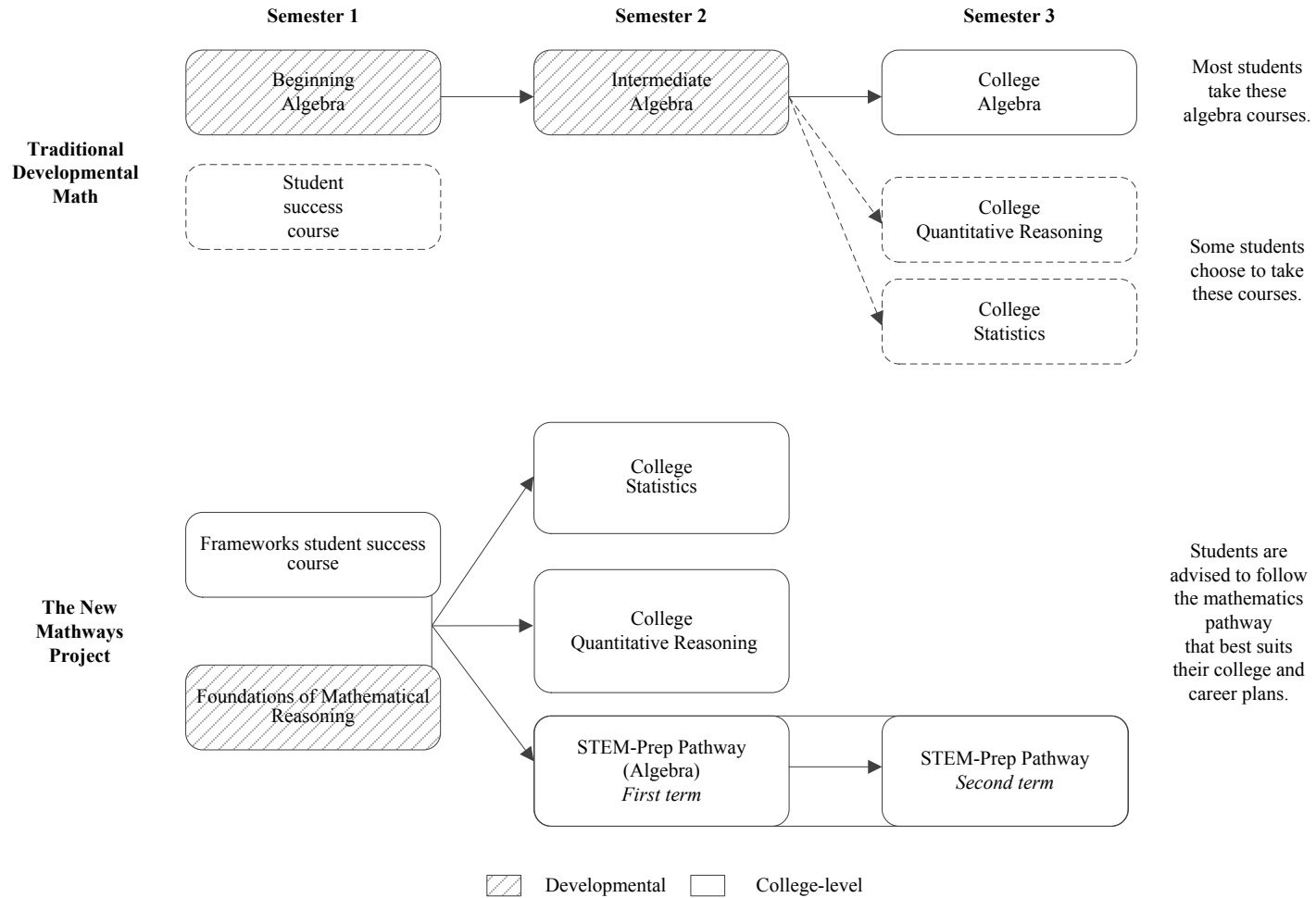
In order to provide a concrete model for the NMP, the Dana Center focused a good portion of its work on the development and implementation of courses for three distinct math pathways.<sup>10</sup> As shown in Figure ES.1, these are (1) a *Statistical Reasoning* pathway, appropriate for students in social sciences careers, such as allied health, government, or psychology; (2) a *Quantitative Reasoning* pathway for students in humanities or general liberal arts fields; and (3) a *Science, Technology, Engineering, and Mathematics (STEM-Prep)* pathway for students pursuing careers that require strong algebraic skills, such as chemistry, computer science, or engineering. Each of the three pathways begins with a common, one-semester developmental math course, *Foundations of Mathematical Reasoning*, which focuses on developing students' quantitative literacy and statistical and algebraic skills. The Dana Center also recommends that colleges pair Foundations with a college-level student success course, *Frameworks for Mathematical and Collegiate Learning*, which focuses on engaging students in the learning theory behind the growth of intelligence, knowledge development, motivation, and self-regulation. After successfully completing these courses, students would enter a college-level math course in one of the three pathways described above. The Dana Center is developing curricular models for each of the three pathways, but it envisions the NMP as an inclusive initiative, with colleges having the flexibility to bring in their own curricular models and structures that align with the NMP's four principles.

These curricular models, and the faculty training associated with them, are one part of the Dana Center's three-pronged strategy for changing colleges' developmental and college-level math pathways. The curricular and instructional supports were developed to support *classroom-level change*, and are meant to aid faculty and staff in revising the math course content. The second prong of the NMP work involves a suite of tools aimed at supporting the *institutional change* that must accompany these efforts, including such resources as an implementation guide, data tools, and advising materials to assist colleges in scaling up multiple math pathways within their colleges. And in the third prong of this effort, the Dana Center is focusing on *cross-institutional reform* through outreach to four-year institutions, documentation on state and national math policies and cross-college transfer requirements, and collaboration with state policy agencies. To facilitate this strategy, they developed a tiered system for the Texas colleges' engagement with the NMP. An initial cohort of *codevelopment colleges* would work closely in developing, piloting, and providing feedback on the NMP courses and other implementation

---

<sup>10</sup>Charles A. Dana Center, "The New Mathways Project Curricular Materials" (Austin: The University of Texas at Austin, 2014), <http://www.utdanacenter.org>.

**The New Mathways Project**  
**Figure ES.1**  
**A Comparison of Mathematics Offerings**  
**for Students with Two Levels of Developmental Need**



tools; *active learning sites* would prepare for NMP implementation in one to two years; and *capacity building sites* would implement the NMP on a slower timeline of three to four years. The Dana Center thus aimed to build a cross-college network and policy environment that would support the integration of multiple math pathways into the fabric of colleges' work.

## Research on the NMP

MDRC has been collaborating with the Dana Center since summer 2012 to study the development and implementation of the NMP initiative. MDRC researchers conducted site visits, classroom observations, focus groups, and interviews to analyze the NMP implementation at all nine codevelopment colleges over three semesters (spring 2013, fall 2013, and spring 2014). MDRC also collected quantitative data on outcomes among developmental education students at the codevelopment colleges from fall 2010 through spring 2014, both within and outside of the NMP courses.<sup>11</sup> MDRC used these data to summarize students' developmental and college-level course enrollment, persistence, and success in NMP and non-NMP courses.

## Key Lessons from the Field

- **With the NMP, the Dana Center developed a highly ambitious initiative that reached above and beyond the goals of traditional developmental education reforms.** In contrast to reforms that have focused on the structure and sequencing of courses, this effort sought to fundamentally alter both the content taught in math courses and students' math trajectories by developing new statistics and quantitative reasoning math pathways. Anticipating that this large-scale revision of course content would have far-reaching policy implications, the Dana Center developed an institutional model and supports for the NMP that sought the input and collaboration of faculty, staff, and administrators at all levels of the institution. Center staff members also sought to foster relationships and agreements with key national, state, and mathematics organizations that would support the adoption of the NMP and the revision of policies that might hinder its spread. The goals for scaling up the NMP within Texas were ambitious: specifically, that 75 percent to 100 percent of the community colleges would have at least two NMP pathways in place within five years, and at least 25 percent to 50 percent of developmental mathematics students within each institution would be in an NMP pathway.

---

<sup>11</sup>For this student-level analysis, copies of reports provided to the Texas Higher Education Coordinating Board were obtained from eight codevelopment schools. Student-level data were not available for one community college.

- **The Dana Center made impressive progress in establishing the NMP within Texas during its first two years of development.** Through its partnership with the Texas Association of Community Colleges, the center developed a statewide NMP implementation plan that all 50 Texas community college systems agreed to execute and financially support for 10 years. By the end of 2012, 47 of 50 community college districts were enrolled and engaged with the NMP project, with nine colleges leading the way as codevelopment partners. Additionally, state-level policy work with such organizations as the Texas Higher Education Coordinating Board (THECB) and a committee of 23 colleges and universities across the state helped foster essential changes around developmental education placement and testing.<sup>12</sup> The Dana Center also promoted relationships with Texas four-year institutions and collaborations between two-year and four-year colleges that resulted in 17 four-year colleges signing on to the NMP Transfer Champions Initiative, which aims to address issues of course alignment between schools. As of fall 2014, over one-third (20) of the 50 Texas community college systems were implementing at least one NMP course or pathway,<sup>13</sup> and over 75 percent of public four-year colleges and universities in Texas accepted either statistics, quantitative reasoning, or both as fulfilling their core math requirements for certain majors.
- **Most faculty, staff, and administrators at the codevelopment colleges supported implementing multiple math pathways within their colleges, but they had concerns.** Faculty and staff at over two-thirds of the colleges were strongly supportive of the Dana Center’s design of the NMP model and its key components, particularly the accelerated developmental math course and movement toward statistical and quantitative reasoning math pathways. However, faculty, staff, and administrators at virtually all the codevelopment colleges raised serious concerns about the transfer and applicability of the NMP math courses at four-year colleges and universities. In addition, faculty and staff noted potential conflicts the NMP might have with other initiatives they were undertaking and the high workload associated with implementing the new courses. Finally, a few math faculty members expressed anxiety over the lack of algebra in the NMP courses.
- **Colleges faced notable obstacles in recruiting students for the NMP, especially over the question of course transferability.** Fearing that four-year

---

<sup>12</sup>Texas Higher Education Coordinating Board, “Negotiated Rulemaking Committee on Texas Success Initiative,” July 2014, <http://www.thecb.state.tx.us>.

<sup>13</sup>In multi-institution systems, generally only one or two campuses were implementing an NMP pathway.

schools would require students to take the developmental and college-level algebra courses, most of the colleges limited the number of students targeted for the NMP courses and instituted complicated enrollment processes in an attempt to ensure that the right students were placed into the courses. Given this targeting, it is perhaps not surprising that nearly all the colleges had difficulty recruiting students into the NMP Foundations and Frameworks sections, with most colleges having only one or two sections of these courses. Three co-development colleges have continued to struggle with enrolling students, and two of these canceled or restructured their classes in fall 2014. A number of recruitment issues also resulted from challenges with coenrolling students in the Foundations and Frameworks classes, as many students had already taken a success course (and thus were considered ineligible for Frameworks) or did not want to take one when it was not required for their degree.

- **Despite some reservations over course content, faculty implemented the NMP courses with a high level of fidelity to the Dana Center design and saw positive differences in students' math learning and engagement in the classes. Classroom observations confirmed that teaching and learning in the NMP courses looked qualitatively different from traditional math courses.** In interviews, most faculty emphasized that they were closely following the Foundations and Frameworks course curricula, despite some concerns that curricula did not contain enough algebra or “math content.” Faculty teaching Foundations and Statistical Reasoning courses at most colleges felt that students seemed engaged with the math course content and that students were holding each other accountable for both their work and their attendance. Observations of the NMP courses confirmed a high level of fidelity to the course design, with students in Foundations and Statistical Reasoning split into small groups, interactively working on multistep math problems focused on real-world content. These interactions were in sharp contrast to most non-NMP developmental math and statistics courses, which were centered on the teachers' lectures, the memorization of formulas or principles, and repeated individual practice of a new concept.
- **The majority of students were positive about the NMP courses, particularly the revised content and acceleration that the courses provided.** In focus groups, students commonly remarked on the relevance of the course materials to their lives and expressed excitement over the acceleration that the pathway offered for completing their math requirements. Students at most schools also generally liked the Frameworks course and the opportunities it provided to expand their understanding of their own learning, study

skills, and the services the college provided. By the end of the year, students in the NMP classes at most colleges said they would recommend the NMP courses to a friend, emphasizing the relevance of the courses over other math classes they had taken.

- **Descriptive data on outcomes for students enrolled in NMP courses are promising, revealing that 30 percent of these students completed both the NMP developmental math course and the college-level statistics course in the first year.** Out of 233 students enrolled in the NMP Foundations course in the fall 2013 semester, almost 65 percent passed the course with a “C” or higher, thereby fulfilling their developmental math requirements. As shown in Table ES.1, by the end of the spring 2014 semester, 46 percent of the NMP students had enrolled in Statistical Reasoning or another college-level statistics course, and 30 percent of the original students had passed the college-level course. Among students enrolled in non-NMP traditional math sequences at these colleges during the same time, only 25.3 percent completed their developmental math requirements and 8.3 percent completed a college-level math class, on average.<sup>14</sup> Though these differences in outcomes for students enrolled in NMP and traditional developmental math courses cannot be interpreted causally as estimates of the NMP program effects, they suggest the NMP may help students achieve developmental and college-level math milestones.

## Summary

The Dana Center has made strong progress in building the NMP in Texas at both the institutional and state levels, and the initiative is showing promising results in helping students complete their math requirements more quickly. But the Dana Center and their partners still have much work to do in meeting their ambitious hopes to scale up the NMP. They are working diligently to overcome the NMP course transfer and recruitment concerns through outreach to four-year colleges and more explicit efforts to educate college faculty and staff at two-year colleges about the extent to which courses do align with these schools’ requirements. These efforts are already bearing fruit, as shown by the NMP expansion at five codevelopment colleges; yet other schools still face difficulties with enrollment. These stubborn issues underscore the monumental

---

<sup>14</sup>These averages include students in need of three developmental math courses before entering a college-level class, while NMP courses were designed for students in need of one or two developmental courses. NMP outcomes could not be disaggregated based on developmental need. See Chapter 4 of the full report for additional discussion of outcomes among students enrolled in traditional developmental math courses.

## The New Mathways Project

### Table ES.1

#### Math Outcomes Among Students Enrolled in NMP Foundations at Codevelopment Colleges, Fall 2013 Through Spring 2014

Outcome	All Colleges Offering Foundations
Number of codevelopment colleges	7
Students enrolled in Foundations in fall 2013	233
Among students enrolled in fall 2013 Foundations, by spring 2014 (%)	
Passed Foundations with “C” or higher	64.8
Enrolled in Statistical Reasoning or other college-level statistics course	45.5
Passed Statistical Reasoning or other college-level statistics course with “C” or higher	30.0

SOURCE: MDRC calculations using college transcript data.

NOTE: Of the eight codevelopment colleges that provided student-level data to MDRC, one did not offer Foundations in fall 2013.

task that the Dana Center is undertaking in changing the standard math pathways in two-year and four-year colleges.

Despite the challenges, the importance of the NMP should not be diminished. Previously published THECB data suggest that more than 80 percent of students who enter college with some level of remedial math need may never complete a college math course with a grade of a “C” or better.<sup>15</sup> While the small proportion of Texas developmental math students who accomplish this goal may have to figure out which of their community college classes will transfer to a four-year college or university, such a problem might seem like a luxury to the tens of thousands of others who are unable to complete a college-level math class. These statistics reveal the predicament facing developmental students such as Jenny: Far too few are succeeding in mastering math content that is often not needed in today’s careers. Developing new courses that better align with the math skills that are needed, and helping students understand the practical value of these skills, may be an important step toward improving their chances of success — both in college and beyond.

---

<sup>15</sup>THECB accountability system data, as reported in January 2014, for the most recent cohort at the time of writing.



## Chapter 1

# Introduction

*When I started back to school last semester for the first time in a long time, I had five math classes [to complete the requirements for my major], and ... I was still technically remedial ... I was stuck in 0308 [remedial algebra] ... and that was my third time taking it. I failed it the third time with a 62. So every time it was improving — [but] it just wasn't getting me anywhere. — Jenny, spring 2014, student at a college implementing the New Mathways Project courses*

*I remember in the math community, we dreamed up this idea of “math for all” — “algebra for all.” What we’ve got now is “algebra forever” for these students. ... You see these students — the sixth time taking this [developmental algebra math] course. ... You’re looking at someone going into interior design trying to factor trinomials. Policemen, firemen, EMTs ... most people should not be focusing on that narrow piece of mathematics. They should be focusing on mathematics for use. — Uri Treisman, executive director of the Charles A. Dana Center<sup>1</sup>*

After eight years away, Jenny is returning to college to try to complete an associate’s degree in small business administration, but there is one big stumbling block in her way: math. “I don’t have that background of math down very well. ... I can’t do the simple things that everyone else can do,” she says as the fall 2013 semester begins. Though she has successfully completed a number of college courses, she has been unable to pass developmental algebra — a set of mandatory preparatory math courses that are aimed at building her math skills and improving her success in college-level math. Like many community colleges across the country, Jenny’s college requires that students take anywhere from one to four of these preparatory math courses (depending on their math skill level) before entering a college-level math class, a key requirement for the completion of most college degree plans. For Jenny, algebra in traditional developmental courses has been difficult to understand: They just “try to find the answer for  $x$  ...” [But] I don’t really care what  $x$  is. ... When did we ever find  $x$  in real life?” Yet Jenny must successfully complete these courses — as well as a college-level math class — in order to get her degree. And she is visibly stressed about her chances of passing this semester. “I have cried. I’ve thought about quitting. I have thought, ‘What in the hell was I thinking going back to school?’”

---

<sup>1</sup>Treisman (2011).

Galvanized by the experiences of students like Jenny, Uri Treisman and the Charles A. Dana Center at the University of Texas-Austin, an organization focused on mathematics and science reform in K-12 and postsecondary institutions, became focused on rethinking this math challenge. Building on their alliance with the Carnegie Foundation for the Advancement of Teaching (2009-2012) in creating Statway and Quantway,<sup>2</sup> the Dana Center launched the New Mathways Project (NMP) in collaboration with the Texas Association of Community Colleges (TACC) in spring 2012. The NMP is an initiative aimed at changing the standard pathways into and through college math. Key to this work is the development and implementation of accelerated, non-algebra-intensive math pathways that are more aligned with social sciences, health, and liberal arts professions while also providing a revised model for the algebra pathway for students embarking on science, technology, engineering, and math (STEM) careers. The Dana Center supports implementation at the institutional level through tools, resources, and services focused on planning, staff training, curricula, and instruction. At the same time, the center works at the state level to leverage the collective power of the Texas community colleges to identify and address policy obstacles.

The Dana Center anticipated that this type of large-scale revision of course content — and the development of new statistics- and quantitative reasoning-based math courses — would have more far-reaching implications for institutional and state policy. The development of new math pathways necessitates changes to the math courses required by many degree plans (many of which recommended or required college algebra); to developmental education testing and placement requirements (virtually all of which are based around assessments of students' algebra skills); and to the transfer policies between two-year and four-year institutions (within which college algebra was the most common requirement or option for graduation regardless of major). Therefore, the Dana Center partnered with TACC to cultivate the political and state environment that would help foster these changes, resulting in a statewide NMP implementation plan in spring 2012 that all 50 Texas community college systems agreed to. Through these agreements, the Dana Center and TACC, along with the Texas community colleges, aimed to work at scale to fundamentally alter Texas's developmental and introductory college-level math course sequences as well as the state math policies for both two-year and four-year college institutions.

This report analyzes the development of the New Mathways Project from spring 2012 through its first year of implementation at nine colleges in Texas in 2013-2014, as well as student outcome trends at the colleges before the NMP began and during that first year. Overall, this study found that the Dana Center made significant progress in laying the groundwork for multi-

---

<sup>2</sup>Statway and Quantway are two alternative, yearlong developmental and college-level math pathways based on statistics and quantitative reasoning. They are now part of the Carnegie Foundation for the Advancement of Teaching's Pathways Improvement Communities and have been or are currently being implemented by 49 institutions across the country.

ple math pathways in Texas, negotiating with state policymakers as well as faculty and administrators from both two-year and four-year institutions to develop a structure for the NMP implementation at colleges in Texas. Most of the faculty, staff, and administrators at the first nine colleges offering NMP courses were supportive of multiple math pathways, and they implemented the NMP courses with a high level of fidelity to the Dana Center's design. But these colleges did face some notable obstacles in executing the NMP, including faculty reservations about the specific course content and about whether the courses would adequately serve students transferring to four-year institutions. Despite these challenges, 20 of the 50 Texas community college systems were implementing at least one NMP pathway by fall 2014.<sup>3</sup> In terms of outcomes, descriptive data on the NMP course completion and pass rates are promising. While fewer than 10 percent of students taking traditional developmental courses at these colleges completed a college-level math course in the same year, 30 percent of NMP students completed both the NMP developmental math course and the college-level statistics course in the first year.

The remainder of this chapter examines the key challenges that developmental math poses for students' college success and the ways in which the Dana Center seeks to address these challenges through the NMP. The chapter discusses both the broader design principles underlying the NMP and the initial steps the Dana Center took from spring 2012 through spring 2014 to support colleges' introduction of the initiative. The chapter concludes with a discussion of the data collection MDRC undertook to examine the NMP's development and implementation.

## **The Challenges with Developmental and College-Level Math**

Recent research on developmental education has shown that students like Jenny are not atypical in community colleges. Both national and Texas-based studies find that anywhere from 50 percent to 70 percent of students arrive at their local community college unprepared for college-level math each year.<sup>4</sup> Upon entry, most students are required to take a developmental education placement exam, with those scoring below a designated cutoff placed into a sequence of one to four developmental courses, based on their level of need.<sup>5</sup> Research has shown that over half the students placing into developmental math need two to four of these courses, meaning they must complete at least one year of developmental courses before being allowed entry into a college-level math class.<sup>6</sup> It is this progression of courses that has traditionally been one of the greatest obstacles to such students' college success. More than 50 percent of students in need of two or more developmental courses do not complete these courses within a three-year time period,

---

<sup>3</sup>In multi-institution systems, generally only one or two campuses were implementing an NMP pathway.

<sup>4</sup>Bailey, Jeong, and Cho (2009); Biswas (2007); Texas Higher Education Coordinating Board (2015).

<sup>5</sup>Bailey, Jeong, and Cho (2009); Zachry Rutschow and Schneider (2011).

<sup>6</sup>Bailey, Jeong, and Cho (2009).

primarily because they drop the courses or never enroll in them.<sup>7</sup> Only about 20 percent of students successfully complete a college-level math course during their first three years, a rate that drops to 10 percent for students in need of three or more developmental courses.<sup>8</sup>

As this research has become more well known, policymakers, colleges, and developmental education reformers have been experimenting with a number of approaches aimed at improving students' progress in and success at developmental math. For the most part, reforms have tended to focus on revising the developmental math *course structure and sequence* in ways that will allow students to complete their developmental requirements more quickly. Most reforms have accomplished this by compressing developmental math instruction into modules or multiweek courses, by providing short-term summer math "boot camps" to students with math deficits, or by mainstreaming developmental students in college-level classes with added supports.<sup>9</sup> Some states have been revising developmental education policies wholesale, including drastic measures such as eliminating developmental education altogether (Connecticut) or barring colleges from mandating these courses for underprepared students (Florida).<sup>10</sup>

Though these initiatives have shown some promise in improving students' progress through developmental education,<sup>11</sup> they have generally not addressed another issue that may be critical to students' success: the type of *math content* taught in developmental and college-level math courses. Recent research has shown that only 22 percent of all workers use simple algebra, while even fewer professions (5 percent) use the higher-level algebra and calculus skills that most college algebra courses teach. Instead, most careers rely heavily on basic middle school math skills, such as division, multiplication, and fractions, as well as quantitative literacy skills, such as the ability to problem-solve and comprehend written statistical charts and graphs.<sup>12</sup> Thus the developmental and college-level math classes that most students are required to take rarely prepare them for the real-life math they will use in their careers.

Additionally, few math reforms have attempted to address the socio-emotional needs of developmental learners, who have often struggled with math learning throughout their schooling. The decontextualized nature of math instruction in college classes, where the teaching of formulas and equations is generally divorced from the real-life applications of math concepts, may exacerbate these issues.<sup>13</sup> Some argue that new mathematics reforms must ad-

---

<sup>7</sup>Bailey, Jeong, and Cho (2009).

<sup>8</sup>Bailey, Jeong, and Cho (2009); Zachry Rutschow and Schneider (2011).

<sup>9</sup>Fong and Visher (2013); Adams, Gearhart, Miller, and Roberts (2009); Jaggars, Edgecombe, and Stacey (2014); Zachry Rutschow and Schneider (2011); Fain (2012, 2013); Barnett et al. (2012).

<sup>10</sup>Fain (2012, 2013).

<sup>11</sup>Zachry Rutschow and Schneider (2011); Fong and Visher (2013).

<sup>12</sup>Handel (2010); Smith (1999); Hoyles, Noss, and Pozzi (2001).

<sup>13</sup>Ganter and Haver (2011).

dress these motivational and learning factors in order to produce improvements in students' mastery of math.<sup>14</sup>

## **The New Mathways Project: Designing Multiple Math Pathways**

Building from their initial work in developing diversified math pathways with Statway and Quantway, Uri Treisman and the Dana Center began to investigate opportunities to reform math pathways in their home state of Texas in 2011. Concerned about college math's lack of relevance and unsatisfied with the boutique efforts typical of many developmental math reforms, they became focused on creating a set of math pathways that would revise the *structure*, *sequencing*, and *content* of developmental and college-level courses and that could be scaled throughout a statewide system.

As they sought a partner with which to develop a statewide, multi-institution strategy, the TACC, the main advocacy organization for the 50 independent community colleges in Texas, was also undertaking a significant shift in its work.<sup>15</sup> In a departure from its traditional focus on legislative advocacy, TACC was seeking to redirect its efforts toward the state's new student success agenda and to improve colleges' ability to meet the agenda's goals. TACC highlighted students' low success rates in developmental math courses as a key focus for reform and began discussions with the Dana Center in 2010 to consider how such reform could take place in Texas. These discussions led TACC's developmental task force to recommend that its representatives, the presidents and CEOs of the 50 Texas community college systems, implement the Dana Center's math pathways model as the means for accelerating students' progress through developmental math. In April 2012, these leaders unanimously voted in favor of the proposal, and the New Mathways Project (NMP) was begun.

In summer 2012, the Dana Center began an active period of development to foster the implementation of multiple math pathways in Texas. The Dana Center began by defining four principles around which the NMP model would be centered:<sup>16</sup>

1. **Multiple math pathways with relevant and challenging content aligned to specific fields of study.** The Dana Center recommended that colleges offer at least two math pathways for students to complete their program-specific, college-level math requirements, with at least one pathway that was non-algebra-intensive. Colleges should provide entry into the pathways with a develop-

---

<sup>14</sup>Barker et al. (2004); Strother, Van Campen, and Grunow (2013).

<sup>15</sup>Information from this paragraph comes from a personal interview with Reynaldo Garcia, president and CEO of TACC, on October 30, 2014.

<sup>16</sup>Charles A. Dana Center (2014f).

mental course focused on building students' quantitative reasoning and statistical skills. Finally, the content of the developmental and college-level math courses should correspond to the skills and content knowledge needed in students' programs of study.

2. **Acceleration that allows students to complete a college-level math course more quickly than they would in the traditional developmental and college-level math sequence.** The Dana Center recommended that colleges offer a course sequence that allows students who have mastered arithmetic, either through placement or coursework, to complete a college-credit math course within one year.
3. **Intentional use of strategies to help students develop skills as learners.** In order to foster the skills, attitudes, and mindsets that contribute to success in mathematics and college, the Dana Center recommended that colleges integrate explicit instruction in these skills within students' math pathways. This integration could be accomplished by incorporating such training within math courses, by linking math courses with a student success course, or both.<sup>17</sup> Ideally, this instruction would focus on engaging students in the learning theory behind the growth of intelligence, knowledge development, motivation, and self-regulation in order to help them develop a different orientation to math learning.
4. **Curricular design and pedagogy based on proven practice.** The Dana Center recommended that colleges base their course curricula and instruction on evidence-based practices endorsed by professional mathematics organizations that have shown promise for increasing students' success. Further, the Dana Center hoped that colleges would continuously improve and revise these courses as research produces new evidence.

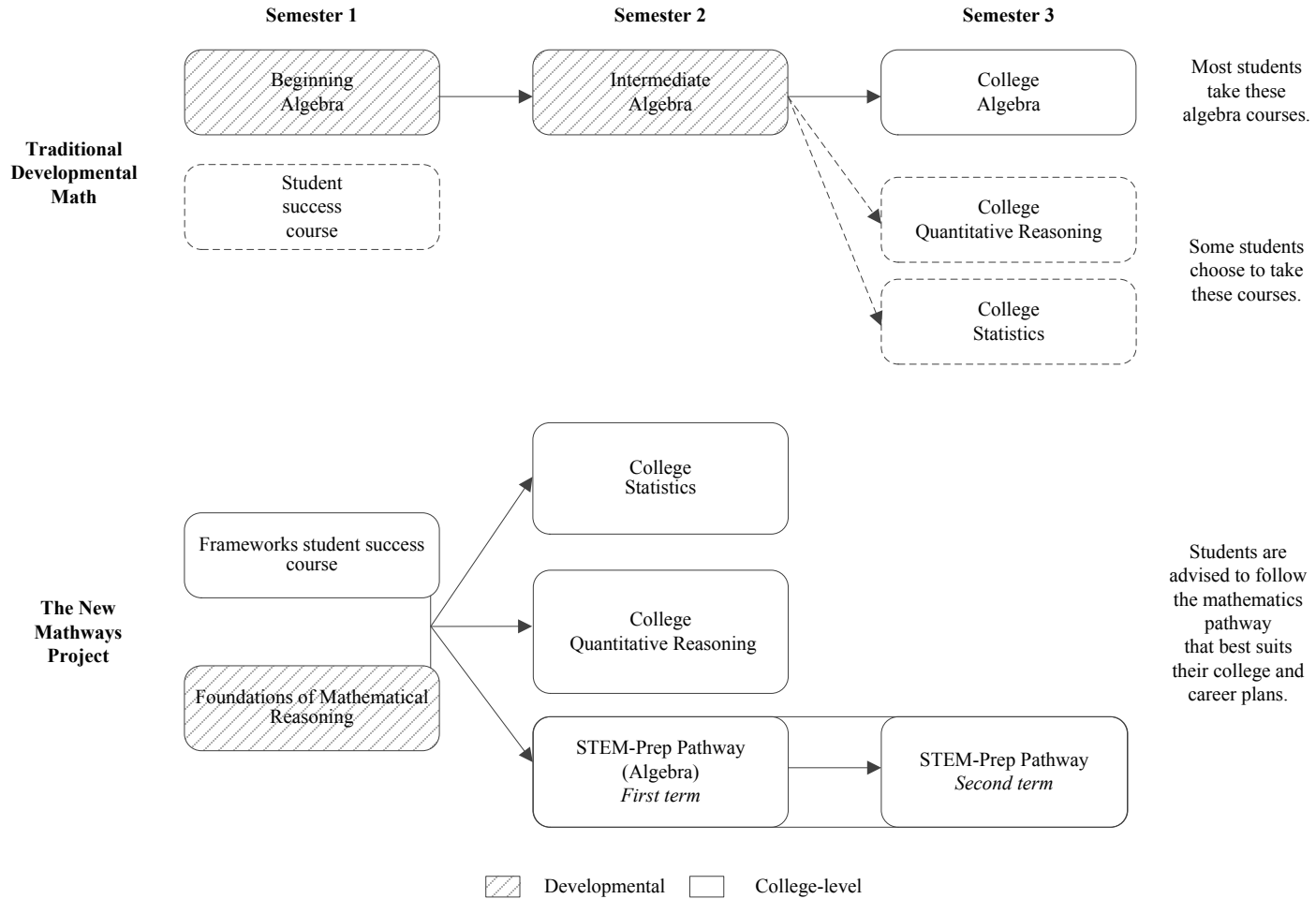
In order to provide a concrete model for the NMP, the Dana Center focused a good portion of its work on the development and implementation of courses for three distinct math pathways, as shown in Figure 1.1.<sup>18</sup> The Dana Center began with a common, one-semester, four-credit-hour developmental math course, *Foundations of Mathematical Reasoning*, which

---

<sup>17</sup>Charles A. Dana Center (2014a).

<sup>18</sup>Information in this paragraph comes from Charles A. Dana Center (2014d).

**The New Mathways Project**  
**Figure 1.1**  
**A Comparison of Mathematics Offerings**  
**for Students with Two Levels of Developmental Need**



provides instruction in skills thought to be integral to students' success in each of the three pathways.<sup>19</sup> Topics in this course include numeracy skills, proportional and algebraic reasoning, and descriptive statistics modeling. In addition, the Foundations course integrates a number of instructional techniques aimed at improving students' engagement with math, such as active learning environments in which students interact closely to solve math problems, the use of real data sets, and the grounding of mathematical problems within real-life situations. The course materials also provide a number of robust nonacademic supports, such as instruction to help students monitor their own learning and build the tenacity to work through challenging tasks, skills that are expected to contribute to their long-term success.<sup>20</sup> Finally, the accelerated design of the Foundations course allows students in need of two remedial courses to complete these requirements in one semester.

The Dana Center also developed *Frameworks for Mathematical and Collegiate Learning*, a three-credit, college-level student success course that could be paired with Foundations.<sup>21</sup> The Frameworks course focuses on developing students' theoretical understanding of knowledge acquisition and metacognitive practices, with such topics as growth models of intelligence, motivational concepts (such as self-efficacy), and the functions and processes of memory. The Dana Center recommended that colleges implement these Foundations and Frameworks courses as corequisites within the same semester, to encourage students' application of learning skills within the Foundations course and to help build a "learning community" cohort across the two courses.

The Dana Center then focused on developing curricula to support colleges' implementation of three college-level math course pathways that would continue from the Foundations and Frameworks courses.<sup>22</sup> Students interested in social sciences careers (such as in allied health, government, or psychology) would enter the *Statistical Reasoning* pathway and take a four-credit college-level statistics course aimed at developing their knowledge of one-variable and bivariate data, probability, categorical data, confidence, hypothesis testing, and the chi-square test. Students pursuing general education or liberal arts careers (such as in graphic arts, journalism, or early childhood education) would enter a *Quantitative Reasoning* pathway and take a three-credit, college-level quantitative math course, which would focus on developing students' algebraic reasoning and modeling skills as well as their ability to interpret, understand, and use quantitative information. Finally, students pursuing careers that require strong algebraic skills (for example, in chemistry, computer science, or engineering) would enter the *Science, Technology,*

---

<sup>19</sup>Note that the four credit hours are developmental credits and, as such, not generally transferable to four-year colleges.

<sup>20</sup>Duckworth and Quinn (2009); Dweck (2006); Yeager and Dweck (2012).

<sup>21</sup>Information in this paragraph comes from Charles A. Dana Center (2014d).

<sup>22</sup>Information in this paragraph comes from Charles A. Dana Center (2014d).



*Engineering, and Mathematics (STEM-Prep)* pathway. Currently under development, the STEM-Prep pathway will involve two semester-long, college-level courses to develop students' algebraic skills in preparation for calculus. The first semester in the STEM-Prep pathway is being designed as an intensive experience to accelerate students' skill building and conceptual understanding. This will require five contact hours, which can be offered in different formats depending on institutional needs, and will result in students earning credit for a college-level course. The second semester in the series is expected to involve a four-credit course. The curriculum for Statistical Reasoning was released in winter 2014, the Quantitative Reasoning curriculum was released in spring 2015, and the STEM-Prep curriculum will be released later in 2015.

Although it is developing curricular models for each of the three pathways, the Dana Center envisions the NMP as an inclusive initiative that can be adapted to different college environments. The center expects that some colleges will have their own internally developed multiple math pathways models and that colleges using the NMP materials will likely modify them according to their own circumstances. But the first nine colleges implementing the NMP, the *codevelopment colleges* discussed further below, were asked to follow the curricular models closely for two years, beginning with the implementation of Foundations and Frameworks in fall 2013 and including at least two of the three NMP curricular models. This report focuses primarily on these colleges' implementation of the Foundations, Frameworks, and Statistical Reasoning courses developed by the Dana Center in 2013-2014.

## **Developing for Scale: Planning for Statewide Implementation**

While much of the Dana Center's initial work concerned the development of curricular materials, these models were just one part of the center's larger systemic strategy for initiating broad-scale math reform in Texas. Overall, the Dana Center took a three-pronged approach to changing colleges' developmental and college-level math pathways:

1. Classroom-based reform, which focused on the development of *curricular materials* and *faculty training* that would support revisions to the direct services students receive
2. Institution-based reform, including such resources as an *implementation guide*, *data tools*, and *advising materials* to help colleges develop the administrative procedures necessary for implementing multiple math pathways at a larger scale within their institution
3. Cross-institutional reform, involving *outreach to four-year institutions*, *documentation on state and national math policies and cross-college transfer requirements*, and *collaboration with state policy agencies*, aimed at building a

college network and a policy environment that would support the integration of multiple math pathways into the fabric of institutions' work

The Dana Center set ambitious goals for the scale-up of the NMP in Texas: 75 percent to 100 percent of the community colleges in Texas would have at least two NMP pathways in place within five years, and at least 25 percent to 50 percent of developmental mathematics students in Texas would be in an NMP pathway.<sup>23</sup> In order to facilitate this scaling, the Dana Center developed a tiered system for colleges' implementation and engagement with the NMP over time, as shown in Figure 1.2. *Codevelopment colleges* would undertake the implementation process early and work closely with the Dana Center in developing the NMP courses, primarily by piloting the courses and providing feedback on the curricular materials. *Active learning sites* committed to learning about the NMP and preparing for implementation in one to two years. These colleges had the opportunity to be mentored by a codevelopment college, and some were already piloting internal math pathways initiatives that aligned with the NMP principles. A third set of colleges, *capacity building sites*, chose to implement the NMP on a slower timeline of three to four years.

The Dana Center also had a vision for its statewide strategy for the NMP implementation. First, its collaboration with TACC brought both political and financial support to launch the NMP, by fostering close links with Texas's 50 community college systems. With these agreements, all the colleges voted for a voluntary increase in their TACC dues for 10 years to support the initiative. TACC also provided a powerful lobbying force for the NMP with the state legislature, resulting in an unprecedented \$2.4 million appropriation in fall 2013 to support the development and implementation of the NMP. And the partnership with TACC furnished a managing board for the design and scale-up of the initiative across Texas.

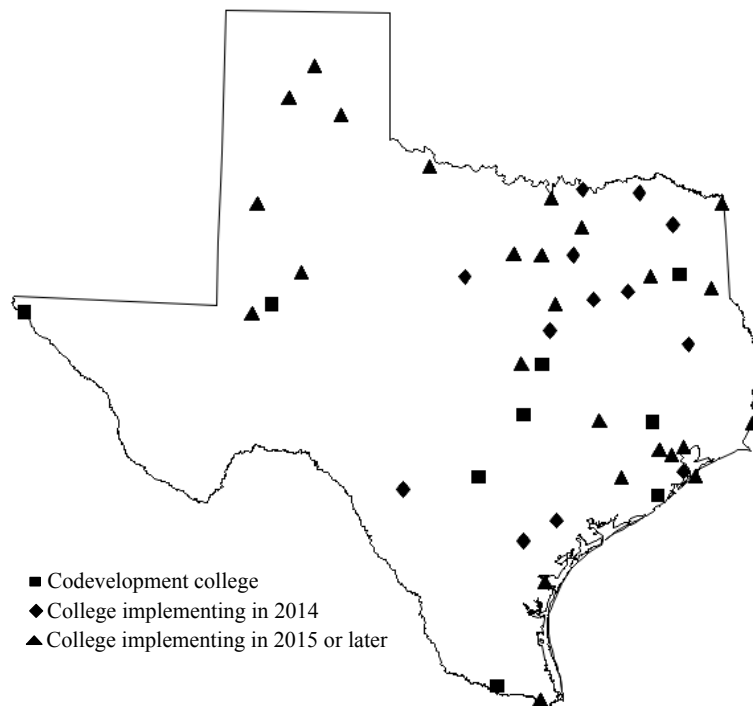
Additionally, the Dana Center encouraged all the Texas colleges to have some engagement with the project early on and make use of information and resources about the NMP. To this end, all participating Texas colleges were asked to identify liaisons to distribute information about the project to colleagues at their schools, including information on the NMP's key design principles and curricular models as well as transfer and policy information that could be helpful to colleges in all stages of implementation. This helped build a statewide network of colleges engaged in the initiative.

To try to address policy challenges that could limit the spread and scale of the NMP pathways, the Dana Center has been working with state organizations such as the Texas Higher

---

<sup>23</sup>Charles A. Dana Center (2014g).

**The New Mathways Project**  
**Figure 1.2**  
**Texas Community College Systems Implementing the NMP**



Education Coordinating Board (THECB), which provides leadership for the Texas higher education system, and the Texas Student Success Council, a group of representatives from K-16 education, business and labor, and nonprofit organizations that helps identify and address problems of policy and funding that set hurdles in the way of college completion. The Dana Center representatives have also met with a number of community college and university organizations in Texas, such as the Texas Council of Chief Academic Officers, the Council of Public University Presidents and Chancellors, and the Community College Initiative, to inform these stakeholders about the NMP and its implications for two-year and four-year institutions.<sup>24</sup> Finally, the center has fostered close relationships with state and national mathematics organizations in order to ensure that the NMP practices and policies are in line with current recommendations for mathematics courses.<sup>25</sup>

<sup>24</sup>Charles A. Dana Center (2014j).

<sup>25</sup>Cullinane (2013); Charles A. Dana Center (2014k).

The Dana Center's math reform ambitions, as well as its focus on both higher-level institutional and policy reform and ground-level classroom change, set the NMP apart from many other developmental math reforms that have focused primarily on restructuring course sequences. Indeed, the Dana Center's work to reform math pathways in Texas positions it as a change agent and offers a potential model for how statewide community college reform may be undertaken at a broad scale across the country.

## **Research on the NMP**

Over the past two years, MDRC has been examining the Dana Center's work in developing the NMP as well as the Texas colleges' preparation for and launch of the project. MDRC researchers observed the Dana Center's trainings and meetings to prepare colleges for the implementation of the NMP and conducted site visits to all nine codevelopment colleges. MDRC conducted interviews, focus groups, and classroom observations at the colleges in spring 2013 (when colleges were preparing for NMP implementation), fall 2013 (the first semester of NMP implementation, when the Foundations and Frameworks courses were offered), and spring 2014 (the second semester of implementation, when college-level statistics courses were offered). During these site visits, MDRC interviewed college administrators, NMP and non-NMP faculty, advisers, and other support staff; observed NMP and non-NMP math and success courses; and conducted focus groups with students attending NMP and non-NMP classes. The main goals of the study were to assess the successes and challenges of NMP implementation and provide feedback to the Dana Center and the colleges on areas for improvement.

MDRC also collected various types of student and faculty data from the codevelopment schools, including data on student and faculty demographic characteristics as well as on students' developmental placement levels, course enrollment and completion, and degree and certificate attainment. In order to get a complete picture of student characteristics and academic achievement at each of the codevelopment schools, MDRC collected data for all students registered at each school, including those enrolled in the NMP or traditional developmental math courses, from fall 2010 through spring 2014, including summer semesters.<sup>26</sup> These data were then used to examine the baseline developmental math outcomes at the codevelopment colleges as well as the outcomes related to student enrollment, persistence, and success in NMP and non-NMP courses.

---

<sup>26</sup>Data were not collected for students who had opted out of redisclosure of their data to third parties, or for dual-enrolled high school students.

## **Structure of the Report**

Chapter 2 examines colleges' preparation for implementing the NMP during spring and summer 2013. Chapter 3 summarizes the implementation of the NMP during the 2013-2014 academic year. Chapter 4 looks at the student outcome trends at the codevelopment colleges before the NMP and after the first year of the NMP's implementation (through spring 2014). Chapter 5 provides conclusions and recommendations for the continued scaling up of the NMP in Texas and beyond.



## Chapter 2

# Preparing for Implementation of the NMP: Spring and Summer 2013

*I've had very mixed emotions about this class. ... Where I'm at, I still don't know if I'm going to pass or fail, but I grasp it (math). Towards the end, I can actually understand it. ... It's like it finally clicked. — Jenny*

*One thing [that's] very important is that we should not think about developmental education in isolation. We should not think about it as only preparing for that first college-level course, but it needs to be the first experience a student has in college; it needs to be attached to their entire college-level program. We like to think of this as an on-ramp to the college-level program. Now, it's a barrier — it's a hurdle that students have to leap over and often don't. — Thomas Bailey, director of the Community College Research Center<sup>1</sup>*

In fall 2013, Jenny began a new track. Her college had just begun implementing the *Statistical Reasoning* pathway of the New Mathways Project (NMP), and Jenny's counselor, noting her struggles with algebra, suggested that she try out the first two courses in the pathway, *Foundations of Mathematical Reasoning* and *Frameworks for Mathematical and Collegiate Learning*. The Foundations course, with its focus on proportional reasoning, descriptive statistics, algebraic reasoning, and modeling using real-life contexts, allowed Jenny the opportunity to try a different approach to math. In addition, the statistics pathway would allow her to complete her developmental and college-level math requirements more quickly. She jumped at the opportunity. Still, she entered the class with trepidation—she mentioned that some days anxiety would seize her and that she was sometimes in tears and felt like quitting. But through the help of her teacher, who she says “calmed me down [and] made me feel a lot better,” she was able to change her mindset from “pity, pity, poor pity me” to “get yourself up, dust yourself off, and ... figure out why you're not grasping it.”

Jenny's college is one of nine codevelopment colleges that partnered with the Charles A. Dana Center at the University of Texas-Austin to help design and implement the NMP pathways. Selected through a request for proposal process in fall 2012, these colleges began implementing the first of three NMP pathways, Statistical Reasoning, in fall 2013. In their role as codevelopers, the colleges agreed to pilot two of three NMP pathways using the Dana Cen-

---

<sup>1</sup>Bailey (2013).

ter's curricula, provide feedback for revisions of the courses, and participate in the leadership of the initiative.

This chapter describes the work the Dana Center undertook to help colleges prepare for implementing the NMP and the colleges' responses and preparations for the project. It begins with a discussion of the nine codevelopment colleges and the specialized role they played in assisting the Dana Center in developing the courses. The chapter then discusses the training and aid the Dana Center provided to faculty and staff and their understanding of and level of support for the initiative. This chapter concludes with a discussion of colleges' efforts to recruit students into the NMP courses during spring and summer 2013. The key findings are as follows:

- The Dana Center provided extensive support for colleges' implementation of NMP, including multiple trainings, a detailed implementation guide, and well-thought-out procedures for informing multiple stakeholders about the implementation process.
- In general, faculty, staff, and administrators at the nine colleges began with and remained committed to implementing the multiple math pathways concept in their schools. They also greatly appreciated the Dana Center's support for the NMP implementation.
- Despite much preparation, nearly all of the colleges faced significant obstacles in recruiting students into the NMP courses. Challenges with recruitment stemmed from a number of issues, including concerns over the ability to transfer the NMP course credit to four-year institutions, limitations on which students were targeted for the intervention, and difficulties with scheduling the Frameworks and Foundations courses together in one semester.

## **Signing on to the NMP: The Nine Codevelopment Colleges**

When joining the NMP initiative, the codevelopment colleges committed to a high level of involvement, including participating in the project for a minimum of two years and establishing faculty and staff teams to work on its development and implementation with the Dana Center. A key role for these colleges was to implement the NMP curricula in their classes and provide feedback for their revision. Codevelopment colleges were also asked to implement at least two of the three NMP pathways, mentor new colleges in the NMP implementation process, and share data on the NMP courses. In return, these colleges would receive free training and support from the Dana Center to prepare for implementation, credit for the work and materials to which they contributed, and opportunities to present and publish on the work.



The Dana Center also had high expectations for the scale-up of the NMP initiative within these colleges in a relatively short period of time. It was hoped that colleges would begin the initiative in fall 2013 by offering either five sections each of the Foundations and Frameworks courses or enough to serve 2 percent to 5 percent of those with one or two developmental math course needs, whichever was smaller. It was then hoped that colleges would more than double the number of sections in fall 2014 to 12 sections or 5 percent to 15 percent of their developmental math offerings. Colleges would then provide an appropriate number of college-level courses in Statistical Reasoning (starting in spring 2014) or Quantitative Reasoning (starting in spring 2015), with the Dana Center hoping that colleges would offer at least 10 of these courses by spring 2015.

The nine colleges selected to participate in the NMP as codevelopment colleges were Austin Community College, Brazosport College, El Paso Community College, Kilgore College, Lone Star College-Kingwood, Midland College, Alamo Colleges District-Northwest Vista, South Texas College, and Temple College. Table 2.1 shows the variety of their demographic profiles, as the school settings range from small, rural campuses to large, urban multicampus systems. This diversity was of great interest to the Dana Center as it sought to learn how the NMP could be implemented in a variety of college environments.

## **Training and Support for Implementation**

The Dana Center provided robust opportunities for building codevelopment colleges' knowledge of and contributions to the NMP. The colleges' work began with a kickoff meeting in December 2012 to consider the development of the NMP courses and the principles behind them, the state-level vision for the NMP, and MDRC's study of the implementation. During the kickoff meeting, the Dana Center provided a detailed guide to the colleges with step-by-step recommendations for NMP implementation, including the development of a college leadership team and suggestions about whom to involve in the process, as well as action plans and timelines for the work.

College faculty, staff, and administrators had further opportunities for communication and discussion in the winter and spring of 2013. These included a State Implementation Team meeting, in which administrators and faculty set the standards for NMP implementation; convenings of advisory groups assisting with the development of the NMP curricula and materials; meetings for institutional researchers to discuss and set parameters around data submissions; and other professional learning opportunities for NMP instructors. During this time, the colleges worked to develop their own action plans for implementation, including communication with college staff about the NMP and advising processes for recruiting and placing students into the

**The New Mathways Project**

**Table 2.1**

**Fall 2013 Student Population at Codevelopment Colleges**

Characteristic (%)	Northwest								
	ACC	Brazosport	El Paso	Kilgore	Lone Star <sup>a</sup>	Midland	STC	Temple	Vista
Gender									
Male	44.5	51.5	42.9	39.2	40.3	40.8	43.4	34.5	44.6
Female	55.5	48.5	57.1	60.8	59.7	59.2	56.6	65.5	55.4
Race/ethnicity									
White	46.6	53.1	8.1	60.7	35.8	45.3	2.7	52.1	27.2
Asian	4.5	1.1	0.7	0.7	6.4	1.9	0.8	2.2	2.9
Hispanic/Latino	29.1	34.8	85.1	13.8	33.8	41.9	93.3	21.3	58.8
Black	7.5	7.3	2.4	20.4	16.8	5.8	0.2	19.9	5.4
Other <sup>b</sup>	6.3	3.2	2.6	3.5	3.2	2.0	0.3	1.6	4.4
Missing	5.9	0.5	1.1	0.9	4.1	3.2	2.7	3.0	1.2
Received Pell Grant <sup>c</sup>	26.1	17.7	46.5	30.5	35.4	20.1	42.3	79.8	28.2
<b>Total student population</b>	<b>41,627</b>	<b>4,127</b>	<b>30,468</b>	<b>5,867</b>	<b>64,072</b>	<b>5,233</b>	<b>31,232</b>	<b>5,506</b>	<b>15,965</b>

SOURCE: MDRC calculations using data from the Integrated Postsecondary Education Data System (IPEDS).

NOTES: Percentages may not add up to 100 due to rounding.

ACC = Austin Community College; STC = South Texas College.

<sup>a</sup>New Mathways has been implemented at the Kingwood campus of the Lone Star College System.

<sup>b</sup>The "Other" category includes students who identify as American Indian/Native Alaskan, Native Hawaiian or Pacific Islander, or two or more races. It also includes students categorized by IPEDS as nonresident aliens.

<sup>c</sup>Financial aid information is based on students enrolled in 2012-2013.

courses. Additionally, the Dana Center worked on creating and providing information on professional development opportunities, course learning outcomes, and curriculum development as well as conducting check-ins with and site visits to the codevelopment colleges.

This development and preparation work culminated in a weeklong Summer Institute in July 2013 that brought together the many faculty, staff, and administrators involved in implementing the NMP at their colleges. Faculty preparing to teach the NMP courses received training to understand the course materials and approach, with opportunities to experience and teach sample lessons. Administrators, institutional research staff, and advisers also attended the institute, where they discussed the overarching issues related to NMP implementation, such as student recruitment, advising, and scale-up, while also working in small groups with their faculty members to plan for course implementation.

The Dana Center also sought to support colleges through the development of curricular materials for each of the NMP courses. Developed during the 2012-2013 academic year, these materials provided lessons for developing students' skills in numeracy, proportional reasoning, descriptive statistics, algebraic reasoning, and modeling (Foundations courses) and their theoretical understanding of knowledge acquisition and metacognitive practices (Frameworks courses). Both courses were modeled around an active learning approach and provide detailed instructions about how to facilitate this type of learning, including preview assignments and warm-up activities aimed at orienting students to new content, interactive instructional plans for small group and class discussions, and data sets and topics connected to real-life problems and issues. The Dana Center provided further suggested materials and practice problems for faculty as well as an online forum where faculty and Dana Center staff could discuss the implementation of lessons and share information.<sup>2</sup> The Dana Center believed that these ready-made resources would help faculty members — particularly the adjunct instructors who have little time for preparation — to more easily implement these courses.

Knowing the challenges of moving a reform beyond the pilot stage, the Dana Center actively sought out ways to engage Texas colleges and their faculty and staff members in the NMP development and implementation process. One key way they sought to do this was by bringing faculty into the NMP curriculum development. When beginning the process, the Dana Center brought together community college faculty with representatives from four-year institutions and professional organizations to develop the learning outcomes and an outline for each course. The Dana Center then developed several prototype lessons, which were reviewed by faculty members, before individual lesson development was handed over to authors, many of whom were teachers from across the country. Additionally, during course implementation, faculty members teaching the courses provided their suggestions for revision to the Dana Center. These sugges-

---

<sup>2</sup>Charles A. Dana Center (2013, 2014a).

tions, which will be used in the curricula, go through a repeated revision process. The Dana Center believes that this cyclical development and revision process will build faculty ownership of the curricula, as well as ensure that they are realistic models for the community college setting.

### **Lessons from the Field**

Overall, faculty, staff, and administrators welcomed the level of support that the Dana Center provided for NMP implementation. In particular, colleges appreciated the Dana Center's status in the field and believed that the center's reputation lent credibility to their efforts to implement the NMP. Faculty and staff members also found useful a number of the materials and supports the Dana Center provided for the NMP implementation. For instance, faculty members appreciated the online forum that the Dana Center developed, which allowed them to share cross-institution lessons and advice on NMP implementation. Additionally, they found the Dana Center's overall guidance on the implementation process and the transfer of NMP courses to be helpful in their planning and development.

Faculty and staff critiques of the preparation process tended to focus on challenges common to any newly developing initiative. For instance, most faculty members involved in implementing the NMP were worried about the actual content of the courses, wondering whether they would be too rigorous — or not rigorous enough. These concerns were exacerbated by the Dana Center's delayed release of the Foundations and Frameworks curricular materials in July 2013, which allowed less time for instructors to become familiar with the course content. Some also expressed fears that the course materials would be too scripted, leaving them little room for adaptation or creativity. Finally, given the NMP's accelerated design, many Foundations instructors were concerned that the Dana Center would pack too much course content into the NMP lessons, making it difficult to teach the curriculum as it was presented.

Faculty and staff also highlighted one area of concern that became critical to the Dana Center's future work on the NMP. At six of the eight colleges interviewed in spring 2013,<sup>3</sup> faculty and staff members noted concerns about the applicability and transfer of the NMP math courses to four-year colleges—and many indicated that they might limit the scaling up of the NMP courses as a result. Several schools mentioned that the institutions to which their students transferred still required algebra as part of the core math requirements for their degrees. While some colleges believed that the Dana Center “would figure this out,” others worried that these transfer issues would make the NMP “applicable for a small sliver of students” and therefore unable to be scaled across their institutions.

---

<sup>3</sup>MDRC visited eight of the nine codevelopment colleges in spring 2013. The implementation plan at Alamo-Northwest Vista was unclear, and MDRC researchers were unable to visit this site.

This concern led the Dana Center to broaden its efforts to connect with four-year universities and colleges. Though it had already hosted a cross-college transfer workshop and begun regional meetings between two-year and four-year institutions in Houston and west Texas in spring 2013, the Dana Center launched a new effort, the Transfer Champions Initiative, in fall 2013 to build awareness of multiple math pathways within four-year colleges. In fall 2013, 17 four-year colleges and universities signed on to the initiative in order to support the NMP implementation in Texas's community colleges and ease transfer of these courses to their own institutions.

## **Faculty Understanding and Leadership of the NMP**

In the NMP implementation guide and in their trainings, the Dana Center encouraged colleges to form a leadership team, made up of a diverse group of faculty and staff, to prepare for the implementation. It recommended that the team consist of a high-level administrator; faculty members and adjuncts representing college-level and developmental math courses and student success courses; a representative from student services; and an institutional researcher. This team was expected to meet monthly and be responsible for working with Dana Center staff to support the NMP. The team was also expected to facilitate the campus-based activities needed for implementation, such as the approval of policies that would allow for NMP courses to be integrated into appropriate college majors, procedures for recruiting students, and mechanisms for evaluating the program.

### **Lessons from the Field**

Most of the faculty and staff involved with implementing NMP courses had a clear understanding of the NMP's goals and vision. Faculty members slated to teach the courses generally understood the NMP's focus on changing pedagogy and content, including the movement toward more statistics- and quantitative literacy-focused content and active learning strategies. As might be expected, advisers' and institutional researchers' knowledge of the initiative tended to be more limited, with most having only general familiarity with the goals of the initiative and less understanding of the pedagogy and content.

Overall, faculty and staff across the eight colleges that MDRC visited also had a high level of commitment to the multiple math pathways concept and believed that alternate math pathways held good promise for increasing students' success. Six of the eight colleges strongly supported the Dana Center's design of the NMP model and its key components, particularly the accelerated design of the developmental math course and the movement toward statistical and quantitative reasoning math pathways. The main concerns about the NMP model stemmed from potential conflicts the NMP might have with other initiatives they were undertaking, such as

developmental math courses divided into shorter, focused modules or internally developed student success courses.

By the time of MDRC's spring 2013 visits, virtually all the colleges had formed leadership teams to prepare for implementing the NMP. The members of these teams generally included the diverse set of staff recommended by the Dana Center. At most schools, the math department chair or dean was the leader of NMP implementation. These leaders tended to be responsible for most of the implementation tasks, including developing the colleges' communication and outreach plans and informing advisers about how the NMP courses fit into their current math offerings. While aware of the NMP and involved in the leadership team, colleges' higher-level administrators, including vice presidents and presidents, tended to know fewer details about the on-the-ground work being accomplished and were instead advocates around resource allocation or institutional policies that could support the implementation. This division of roles and responsibilities aligned well with the Dana Center's expectations that faculty members be the primary leaders behind the NMP implementation.

Though faculty and staff at the colleges tended to be excited about implementing the NMP courses, they did raise concerns about how state policies might interfere with the project. Upcoming changes to the state's developmental education placement exam and policies for developmental course placement were one issue. Before fall 2013, the choice of developmental placement tests and cutoff scores for placement had been at colleges' own discretion, resulting in a variety of exams and policies. In fall 2012, the Texas Higher Education Coordinating Board (THECB), the entity responsible for developing and managing higher education policies in the state of Texas, mandated that colleges begin using the same statewide developmental education placement test and cutoff scores as part of the new Texas Success Initiative (TSI) assessment.<sup>4</sup> From the colleges' perspective, these cutoff scores specified a much narrower range of developmental education eligibility, leading a number of their lower-level students to be placed into adult education or other nondegree track options (also part of the new TSI mandates). In addition, three-fourths of the content of the new placement test focused on assessing students' algebra skills, making it unclear how pathways focused on statistics and quantitative literacy should be managed.

The Dana Center had already been focused on collaborating with the THECB to consider how state policies could support the implementation of multiple math pathways. Colleges' concerns over the new TSI rules pushed the center to redouble its efforts in this area. Beginning in the spring of 2014, the Dana Center worked with the THECB to negotiate a rule change that

---

<sup>4</sup>The THECB began the Texas Success Initiative in 2012, aiming to improve the progress of remedial students by developing reliable diagnostic assessments, intensive advising, and accelerated developmental education interventions by 2017.

allowed two different designations for TSI completion based on coursework, one for algebra courses and another for non-algebraically intensive pathways. After a period of public comment and deliberation, the THECB formally approved the rule change in July 2014.<sup>5</sup>

## **Bringing Students In: Recruitment for the NMP Courses**

The Dana Center hoped that each college would either recruit enough students to fill five sections of the Foundations and Frameworks courses in fall 2013 or make the NMP courses 2 percent to 5 percent of their current developmental math offerings, whichever was smaller. In order to help them accomplish this goal, the Dana Center provided a number of supports for colleges' targeting and recruitment of students, both within the NMP implementation guide and through their trainings. The implementation guide provided extensive recommendations for colleges' planning, outreach, and recruitment of students into the NMP courses. First, the Dana Center recommended that advisers collaborate with institutional researchers and their NMP leadership team to develop a student recruitment plan for the 2013-2014 year. They were encouraged to estimate the number of students eligible for NMP courses, train advising staff on outreach for the NMP courses, and develop advising and marketing tools to inform students of the program. Colleges were encouraged to identify specific majors for which the NMP courses would be appropriate and recommend NMP wholesale to students in those majors. In the interest of maximizing the pool of potential students, the Dana Center suggested that colleges refrain from placing other restrictions on students' eligibility, such as skill level in the other developmental areas of reading and writing. In support of these endeavors, the Dana Center provided PowerPoint slides for training advisers, templates to estimate the size of the NMP target student population, and sample marketing materials to support student recruitment.

Because Statistical Reasoning was the only college-level course that would be ready in spring 2014, the Dana Center recognized that most colleges would need to limit their recruitment to students in majors suitable for that pathway. Therefore they expected that students in science, technology, engineering, and math (STEM) fields would be excluded from NMP courses until the new STEM-Prep pathway course materials became available in the 2015-2016 academic year. This would also be the case for students eligible for the Quantitative Reasoning pathway, for which courses would not be available until 2014-2015. However, the Dana Center recommended that students in Quantitative Reasoning-eligible majors be offered the choice of enrolling in the Statistical Reasoning pathway, which involves comparable college-level math skills.

---

<sup>5</sup>Texas Higher Education Coordinating Board (2014a).

## Lessons from the Field

Most of the codevelopment colleges created specific plans for targeting and enrolling students in NMP courses and provided the Dana Center with detailed plans for their work. Recruitment plans typically specified timelines for determining the majors eligible for NMP courses, educating advisers about the NMP pathways, and training advisers on the NMP eligibility requirements. Nearly all colleges used student enrollment data by major to estimate the number of students who would be eligible for NMP courses, revealing a target population of hundreds (at small colleges) to thousands (at large colleges). Most colleges also developed detailed plans for outreach to students, including posted flyers, mailings, email blasts, targeted phone calls to eligible students, and class visits to recruit students who would be eligible the following semester. Many colleges designated a specific staff person to help advise and register students into NMP courses.

Despite this extensive planning and outreach, recruitment into NMP courses was difficult for nearly all the colleges throughout spring and summer 2013, and all but two colleges fell short of the Dana Center's hopes for enrollment. While eight of the nine codevelopment colleges offered at least one section of a Foundations or Frameworks course, the majority of colleges had only one or two sections of NMP Foundations and Frameworks courses in fall 2013. Three colleges had three sections of Foundations; however, enrollments in the courses tended to be small, with most courses having fewer than 15 students. Colleges had similar numbers of sections and enrollments in Frameworks as in Foundations, with the exception of one college that scaled the Frameworks offerings to serve all developmental education students (after having piloted the course for the Dana Center the semester before). Finally, one college did not offer any Foundations or Frameworks courses in fall 2013 because it was unable to enroll enough students. Another college implemented only a Frameworks course, choosing to stay with its own internally developed prestatistics course rather than implement Foundations. As Table 2.2 shows, across all colleges, 233 students were enrolled in Foundations in fall 2013 while 585 students were enrolled in Frameworks courses.

### The New Mathways Project

Table 2.2

#### Enrollment in NMP Courses at Codevelopment Colleges, Fall 2013 Through Spring 2014

Semester	Students Enrolled in NMP Course		
	Foundations	Frameworks	Statistical Reasoning
Fall 2013	233	585	
Spring 2014	110	268	155

SOURCE: MDRC calculations using college transcript data.



MDRC's interviews with faculty and staff at eight of the nine colleges shed light on the numerous reasons behind these low enrollments. First, though many colleges had estimated that the NMP target population could be hundreds to thousands of students, very few of them recommended NMP courses to these students wholesale, primarily because of their concerns with the transferability of the courses. Most of the codevelopment colleges limited recruitment because they feared that NMP courses would not satisfy the math requirements at four-year colleges.<sup>6</sup> Faculty and staff at these colleges tended to hand-select students who did not intend to transfer. Two-thirds of the colleges also developed lengthy processes for NMP course enrollment, such as requiring students to sign a contract, get the approval of the math department chair, or meet with specialized advisers, which often required shuttling through multiple buildings or making an extra trip to the campus. Finally, a few colleges put additional prerequisites on students' entry into NMP courses, such as higher-level reading skills, which further narrowed the eligible population.

Advisers' limited knowledge of the NMP was another important factor in the reduced enrollments. Though advisers connected to the leadership team generally had detailed knowledge about NMP, the larger advising teams at four of the colleges knew relatively little about it, and they too expressed concerns about the NMP courses' transferability.

Another set of recruitment issues stemmed from the Dana Center's recommendation that students enroll in both the Foundations and Frameworks classes in the same semester. Though many colleges had student success courses, the Dana Center believed that the Frameworks course would help students make direct connections between the theories of learning from Frameworks and the related practices embedded in Foundations, thus contributing to their math success. Additionally, because the Frameworks course was developed as a college-level course, they expected it to provide an attractive alternative to colleges' other success courses, which tended to be developmental or noncredit courses.

However, because of the widespread implementation of student success courses at the codevelopment colleges, many NMP-eligible students had already taken a success course, leading many colleges to exclude them from the NMP target population. The Frameworks course also created challenges at schools where success courses were not mandated, as students were hesitant to enroll in a course that was not required or that they perceived to be less applicable to their major. Some advisers also noted having difficulty selling the seven-hour Frameworks and Foundations series to students when other math offerings demanded fewer hours of them. Finally, when there were only a few sections of Frameworks and Foundations available, it was difficult to fit both courses into students' schedules. This challenge was exacerbated at the six colleges that attempted to link the two courses, requiring the same group of students to enroll in

---

<sup>6</sup>This count includes the college that implemented its own prestatistics course instead of Foundations.

both. These difficulties ultimately led five of these schools to drop the linking of the courses by the spring 2014 semester.

## **Summary**

Given the ambitiousness of the NMP and the fact that many problems, such as the applicability of NMP courses at four-year colleges, had yet to be resolved, the lower enrollments in NMP courses are not necessarily surprising. Enrollment difficulties are common even among less ambitious classroom reforms, such as learning communities, which attempt to link a student success course with a developmental education course.<sup>7</sup> Large-scale implementation of classroom reforms has tended to occur most often in situations where a college mandates the change for all students, a difficult thing for most codevelopment colleges to undertake given the applicability issue. Still, these low course enrollments signaled that the “built for scale” NMP initiative faced a number of challenges the Dana Center needed to address in order to meet its hopes for the NMP’s widespread adoption.

---

<sup>7</sup>Visher et al. (2012); Zachry Rutschow et al. (2011); Quint et al. (2011).

## Chapter 3

### Initial Implementation of the NMP Courses

*Instead of going to my husband, asking how many Christmas lights we need to go across the house, I can figure it out. Take that! ... I figured out the formula — I wrote it out — and figured it out. ... I get excited because I can do math ... on something someone needs to do every day. — Jenny*

*The routine shortcuts used in most math classes fail to teach students the value of math in representing other phenomena, so they can't use the math they have learned in other settings. ... Math becomes a self-contained subject, a requirement for transfer or for other courses, but not something valuable for its applications in other subjects and its areas of life outside school. — Norton Grubb, professor emeritus, University of California-Berkeley<sup>1</sup>*

Jenny nearly pops out of her seat. “I like it that I can go and figure out how many strands of Christmas lights I need on my house without my husband. That was ... a big accomplishment.” She still doesn’t know if she is going to pass the course, but Jenny can tell you a myriad of ways that she understands math better than she ever has. “It’s different because it’s not ‘Try to find the answer for  $x$ .’ ... It’s more real life stuff, so you can relate to it. And that’s how I think I understand it better.” Jenny is about halfway through her Foundations course and can’t say enough about how it is different from past math courses she’s had. Another student in her class agrees: “Instead of just memorizing a formula, you’re understanding how it’s used — how you can apply it in real life.” It has even changed Jenny’s perspective of herself — almost. “I’m telling you, [before Foundations] I could not take a fraction and turn it into a decimal. I could not take a decimal and make it into a fraction. I was dumb. Dumb.” She may not be fully confident in her expertise, but math in Jenny’s world is definitely looking different from the way it did before.

Beginning in fall 2013, eight of the nine codevelopment colleges that joined the New Mathways Project (NMP) initiative in fall 2012 implemented at least one NMP course, with most colleges implementing both the NMP’s Foundations of Mathematical Reasoning statistics- and quantitative-reasoning-focused developmental math course and the Frameworks for Mathematics and Collegiate Learning college-level student success course. In spring 2014, most of the colleges followed this by offering the NMP’s Statistical Reasoning course, using the Dana Center’s NMP curriculum in all three courses. This chapter describes the colleges’ experiences implementing these three NMP courses during fall 2013 and spring 2014. It begins with an

---

<sup>1</sup>Grubb (2013).

analysis of the implementation of the Foundations and Frameworks courses and the supports that the Dana Center provided in this process, then examines colleges' implementation of the Statistical Reasoning courses. Faculty and student responses are interspersed throughout. The key findings from this chapter are:

- College faculty generally implemented the NMP Foundations, Frameworks, and Statistical Reasoning courses with fidelity to the Dana Center model, including coenrolling students in Foundations and Frameworks, having successful students enroll in Statistical Reasoning classes, and using the Dana Center-designed NMP curricula throughout the courses.
- NMP math courses (Foundations and Statistical Reasoning) looked qualitatively different from traditional math courses, with high levels of student engagement with problem-solving activities, small group learning, and teachers facilitating learning through short lectures and individual support.
- Faculty generally responded positively to the real-world applications inherent in the NMP curricula, but about half the faculty cited concerns, including the heavy load of preparation needed to implement the course and a perception of missing algebra or math content.
- Students responded positively to the Foundations and Statistics courses, highlighting the differences between these courses and those they had taken in the past. Students particularly appreciated the alternative, non-algebra-focused content and the application of math within a real-world context.

## **Building It from the Ground Up: The Codevelopment Colleges' Implementation of Foundations and Frameworks**

In July 2013, the Dana Center released the curricula for the Foundations and the Frameworks courses, allowing faculty members about five to six weeks to become familiar with the materials before teaching them. The courses were built to serve as a common starting point for each of the NMP's three pathways, including Statistical Reasoning, Quantitative Reasoning, and STEM-Prep. The Foundations course was designed as a one-semester, four-contact-hour developmental course, which could be offered as one class section or a combination lab and instruction course.<sup>2</sup> The course was to be recommended to students who had one or two developmental math need(s), with students expected to have at least a basic understanding of number operations, fractions, decimals, and percentages.

---

<sup>2</sup>Charles A. Dana Center (2013).

Active learning serves as the primary pedagogical approach in all the NMP courses. In Foundations and Statistical Reasoning, students are “expected to actively *do* [math] — such as analyzing data, constructing hypotheses, solving problems, reflecting on their work, and making connections” among and between mathematical concepts.<sup>3</sup> Each course was designed around a set of learning goals that sought to develop students’ ability to communicate using math; problem-solve; reason and make decisions using mathematical, statistical, and quantitative information; evaluate the quantitative arguments using mathematical information; and use appropriate technology to apply mathematical concepts. (See Box 3.1 for a sample Foundations lesson.) In addition, each course has a set of content learning outcomes, which in Foundations includes strengthening students’ numeracy skills; proportional reasoning skills; algebraic competence, reasoning, and modeling; probabilistic reasoning to assess risk; and quantitative reasoning in personal finance and civic life. To accompany the Foundations course, a technology package was developed to be the primary vehicle by which students were to complete their homework assignments and receive extra assistance with their in-class learning.<sup>4</sup>

The college-level Frameworks was developed to meet the criteria set forth in the Texas Academic Course Guide Manual for a cross-listed psychology and education course (PSYC or EDUC 1300).<sup>5</sup> The course teaches students the research and theory behind the psychology of learning, cognition, and motivation; the factors that affect learning; and the application of learning strategies. (See Box 3.2 for a sample Frameworks lesson.) The theories central to the Frameworks course include Carol Dweck’s concept of the growth of intelligence; Albert Bandura’s social learning theory; Bernard Weiner’s attribution theory of motivation and emotion; and Paul Pintrich’s and Barry Zimmerman’s models of self-regulation, including John Flavell’s work on metacognition.<sup>6</sup> Within the Frameworks courses, students were also expected to apply these theories to themselves, using learning inventories that help them identify their strengths and weaknesses as strategic learners.

The students enrolled in the NMP classes tended to mirror their colleges’ demographics (see Table 2.1 in Chapter 2). Most classes were evenly split by gender, with a mix of Hispanic, African-American, and white students similar to each college’s overall makeup. Students ranged in age from just out of high school to much older, with some adults returning to college after many years away.

---

<sup>3</sup>Charles A. Dana Center (2014h), p. 2.

<sup>4</sup>Charles A. Dana Center (2013, 2014a, 2014h).

<sup>5</sup>Charles A. Dana Center (2014a, 2014d).

<sup>6</sup>Charles A. Dana Center (2014b).

### Box 3.1

#### A Sample Foundations Lesson: Measuring Blood Alcohol Content

This lesson builds on previous lessons in which students were introduced to the use of variables in mathematical equations. Key goals of those lessons were for students to begin to understand how substituting one variable for another can yield a simplified formula and to be able to write out the order of operations to evaluate a given formula. In this lesson, students are expected to expand on this as they simplify the formula and analyze the sequence of steps needed to determine blood alcohol content (BAC). The formulas here are more extensive than previous ones, involving the use of multiplication and addition. The key goals are for students to understand how the location of a variable affects the size of an expression and to be able to write out the order of operations to evaluate a formula.

The lesson begins with the distribution of a handout that provides an introduction to the measurement of BAC, the formula used for estimating it, the variables in the formula, and four discussion questions to consider during the lesson. The teacher then asks students to think about the variables in the equation (question 1) and talk with one another about their thoughts. After several minutes of this, responses from students are taken within class as a whole, with discussion focusing on why each variable and its location might be important to the BAC calculation. In addition, the class talks about how certain variables might change depending on the person being examined, and about the numbers that are held constant within the formula (which is based on the average rate of elimination of alcohol as well as a conversion factor involving individuals' weight, the density of alcohol in a standard drink, and the density of water in an average person). Students then consider the case of a male student who weighs 180 pounds and drinks five beers. In small groups, students are asked to simplify the original equation with these known values so that only two variables remain in the equation (question 2). Using this simplified equation, students are then asked to consider how the student's BAC changes one, three, and five hours after his first drink and what patterns they see in the data (question 3). Finally, students are asked to write down the sequence of steps they used to get to the BAC, being specific about particular steps such as adding, multiplying, or subtracting certain values and the order in which they used them to complete the operation (question 4).

Instructors are given a set of guiding questions to be explored with students as a class or within small groups:

- In an equation with two operations [use an example from the lesson], how do you decide which operation to do first?
- How do you decide which operation to use? What if negatives are involved?
- How can you check if a solution to an equation is correct?

After working through the discussion problems, the instructor wraps up the lesson, emphasizing the new concepts that students learned and having them refer back to the objectives for the lesson (from the handout) to ensure that they recognize them from the activity. The instructor then previews how the lesson will lead to the activity in the next class, in which students will learn how to solve for variables when given the BAC.

### Box 3.2

#### **A Sample Frameworks Lesson: The Plastic Brain and Smart Thinking**

In this lesson, students learn about basic brain anatomy and how neural connections are strengthened with persistence and practice as well as how habits are formed and can be broken. A key goal for the lesson is for students to understand the plasticity of intelligence and how they can increase their learning through purposeful engagement and practice. As pre-work for the class, students are asked to read an article entitled “You Can Grow Your Brain,” which explains that recent advances in brain science (neuroplasticity) have demonstrated that the brain is an adaptable organ that can grow, change, and improve over time (in contrast to earlier concepts that people are born with a certain number of neurons that diminish and die off as we age). The instructor begins the lesson by having students form small groups in which they discuss the three most important ideas from the article. One member from the group summarizes their thoughts for a group discussion with the full class.

The teacher then shows students a short video introducing the main topic of brain plasticity. The video emphasizes that while it’s difficult to get a signal across a neural synapse when people first learn something new, these connections are strengthened over time and become effortless once we have learned the new task. The teacher poses the question, “What happens in extreme cases? What if half our brain was removed because of a debilitating disease?” Another video clip shows how the brain physically rearranged itself in a young girl who had the right side of her brain removed. Students have small group discussions, considering what surprised them about what they learned about the brain and how this connects to learning. The teacher cites a number of studies from prominent institutions such as the National Institute of Health and Rice University to emphasize that the plasticity of the brain is a research-based concept and introduces the idea of purposeful engagement, whereby individuals can choose to change their brains similar to how they would strengthen a muscle in the body. The teacher is encouraged to emphasize the way students may grow smarter through purposeful engagement.

The instruction then dives more deeply into the capability of the brain. In a group discussion, students are asked to guess how many neurons are in the brain (100 billion) and, to make this more concrete, to consider how long it would take them to count these neurons (assuming it took one second to count each neuron). Upon working this out within their small groups, students realize the answer is roughly 3,171 years. This is intended to dispel the myth that people use only 10 percent of their brains, with an accompanying article that critiques that idea. The teacher then discusses how scientists use the analogy of the Internet to understand the brain, where connections between neurons are the key elements for boosting intelligence.

(continued)

### **Box 3.2 (continued)**

The final part of the lesson introduces cognitive psychology and its relationship to neuroscience, along with a video excerpt of Arthur Markman introducing the concept of “smarter thinking,” which emphasizes developing smart habits and acquiring and applying high-quality knowledge. Students are asked to reflect on their own personal habits and consider how habits are formed and broken, with additional video clips of Markman discussing how to change bad habits. Students identify and write down a bad habit they want to break, with two or three students sharing their habits with the class. Students then write a habit diary, in which they consider the times and places when they engage in this habit and the associated feelings. The teacher connects these issues with the habit formation process, emphasizing the connection to a particular environment or place and helping students think through the process of habit breaking. Students are encouraged to monitor the unproductive habit over the next month and keep a journal of their efforts to break it. Finally, this discussion is used to introduce the value of journaling, which will be a key exercise in students’ homework exercises over the course of the semester.

### **Lessons from the Field**

During site visits to the colleges in fall 2013, MDRC researchers found that most of the faculty at codevelopment colleges were implementing the Foundations and Frameworks courses with a high level of fidelity to the Dana Center design. Of the seven colleges that implemented the Foundations courses in fall 2013, all but one college used the Dana Center curricular materials faithfully throughout the semester.<sup>7</sup> Among the eight colleges that implemented the Frameworks courses, seven followed the Dana Center Frameworks curricula closely.<sup>8</sup> In observations of NMP classrooms, Foundations faculty were focused on developing skills such as estimation, graphical analysis, and understanding distributions and proportions. Frameworks courses were focused on activities that built students’ understanding of the brain and theories behind knowledge acquisition while also developing students’ awareness of campus resources, motivation for college success, and use of study strategies and skills. Though a few faculty did mention making minor alterations to the courses, such as removing some activities in order to fit a lesson within one class period, all the colleges but one stayed with the basic outline and framework for the course lessons.

---

<sup>7</sup>Two codevelopment colleges did not implement the Foundations courses. One college was unable to enroll enough students to offer the course until spring 2014, and the second college chose to stay with its own accelerated prestatistics developmental math course.

<sup>8</sup>One codevelopment college did not implement Frameworks because it was unable to enroll enough students to offer the course.



The pedagogical approach and student interactions in the NMP Foundations courses were visibly different from those in non-NMP developmental math courses. Upon entering NMP classrooms, observers quickly noted students' talkativeness and steady interactions with one another, with multiple students chatting about previous lessons or life situations. Foundations students worked primarily in small groups, interactively solving multistep math problems focused on real-world content. The group work was peppered by occasional short lectures from the teacher around specific issues with which different student groups were struggling. Larger group discussions also occurred, allowing students to share particular solutions to a problem with one another. These interactions were in sharp contrast to the format of most non-NMP developmental math courses, which centered around the teachers' lectures on a particular concept and students individually practicing the concept at their desks. In many cases, instructors in these developmental math classes focused on teaching a specific formula or variable, encouraging students to memorize the formula and practice its application repeatedly during class. Though there were some instances of small-group learning in developmental math courses, overall these courses did not focus on active learning to the extent that the NMP courses did.

### **Teaching and Learning in the NMP Classrooms: The Faculty Perspective**

In general, faculty members teaching Foundations and Frameworks courses appreciated the grounding of the curricula in real-world contexts. One teacher discussed how these real-world contexts helped engage students in learning math: "Yesterday in class, we were computing BMI [body mass index], and all of a sudden, I saw a group of girls not really paying attention — they were computing their own BMI!" They also appreciated how the contextualized math problems pushed students to critically analyze quantitative information in their own worlds. As one faculty member noted, "This class teaches students to think. ... It gives them a boldness — there's a confidence there. ... There are so many things that are practical, real world. ... They'll [students] challenge what they saw in a magazine; they'll challenge what they heard on the TV. They've grown mathematically."

Some faculty members who taught Foundations courses also noted positive differences in students' work and engagement in class. As one staff member said, "Students seem more engaged [in the NMP classes] because it's fast paced, [and they are] working in groups." In addition, faculty believed that students were holding each other more accountable for both their work and attendance in the NMP classes. As one instructor said, "Students become not just mathematically ready, but mature students. They learn how to study together — how to get into groups and work outside of class. These students work a lot outside of class together. Those are things you don't get in a regular developmental course, as much as you try."

In interviews, most faculty members teaching Foundations and Frameworks emphasized their intention to implement the Dana Center curricula faithfully, even in cases where they

disagreed with the content. Faculty members at about half the colleges commented on their desire to supplement the courses with some of their own materials; however, most refrained from adding in many additional resources, emphasizing their efforts to provide the Dana Center with a more pure implementation of the curricula. As one faculty member noted, “We’re doing it [the Foundations class] the way it was presented to us. . . . [Based on our knowledge] as teachers and our educational philosophy — we know what needs to be added to it. But our data has to be that we’re using this product, and does it work or does it not work?” All the colleges also provided feedback to the Dana Center on their suggested revisions to the curricula, with a few colleges heavily involved in this process on a weekly basis.

Although there were many positive aspects of NMP implementation, a number of faculty members raised concerns about the preparation and the curricula. Faculty at almost all of the colleges noted the heavy lift in preparing for NMP courses or trying to fit all the content within the more active-learning-focused lessons. Some commented that they spent many hours preparing for courses, with one instructor declaring, “I have an adjunct that’s taking over for me and it’s a lot of work for her. . . . She’s having to do so much extra work, as compared to if she was taking over my Algebra class.” Others noted spending a lot of time helping students outside of class, given that most of the class lessons were devoted to small-group learning. One faculty member stated, “I have three weekly study sessions with them for homework only — so I meet with them three additional hours where they can come in.”

Faculty members at four of the colleges also expressed concerns over the content of the courses, with some worrying that the Foundations course did not have enough math, was too rigid, or was less rigorous than traditional developmental math courses. For example, one Foundations instructor had concerns about rigor behind the exam questions, arguing that an answer was “no indication that a student was ready for a college level statistics course.” About half of those teaching Frameworks courses had similar concerns, noting either the lengthy amount of time needed to prepare and implement the course or the view that the course packed too much into the lessons.

The technology component, intended to supplement and support the NMP courses, also caused problems. Faculty and students both said that the instructions that were meant to guide students in their work were too ambiguous and that the program provided incorrect answers or did not recognize correct answers. These difficulties with the homework platform hampered students’ engagement at a number of sites, and instructors at two colleges stopped using it altogether.

### **Teaching and Learning in the NMP Classrooms: Student Responses**

In the focus groups conducted with students at the eight codevelopment colleges that implemented NMP courses in fall 2013, students at the seven colleges that offered Foundations

responded positively to the course's accelerated nature and nonalgebra content. Students at several colleges were excited that they would be able to complete their developmental and college-level math requirements in one year. In one student's words, "I took this class so that I wouldn't have to go through so many remedial classes. . . . That's all I heard — fewer classes!" Students who had had trouble with algebra appreciated having a different math option.

Interestingly, while many students spoke disparagingly about algebra from past experiences, the activities from Foundations that they found most engaging often covered algebraic content. For instance, classes in which students measured BMI or calculated someone's blood alcohol content focused on the use and manipulation of algebraic formulas. Overall, students argued that the context made mathematics seem more approachable and interesting. As one student explained, "I did the whole blood alcohol level thing on my husband a few weeks ago. I was like, 'Your blood alcohol level is approximately *this*.'" Another student emphasized how this approach helped make the math they were learning more relatable: "Instead of just memorizing a formula, you're understanding how it's used — how you can apply it in real life." It appears the application of the algebraic content to real-life situations helped counteract their negative perceptions of the content.

Students were of mixed opinions about the active learning approach and the small-group work that dominated NMP classes. A number of students appreciated the opportunity to interact more closely with their peers in the NMP courses. As one student emphasized, "If there's anybody [who is] lacking the [information] . . . somebody else can help them out." Others appreciated how the group work allowed them to learn in different ways, "befriend people in [the] groups . . . and . . . learn different ways to do problems." Some students were less positive, noting that the interactive approach interfered with their learning or limited the time they had to learn content. As one student explained, "it was hard — there was no lecture. . . . It took forever to figure everything out. . . . We have a lot of math anxiety . . . so when you're not getting help, all you do is regress, and you shrink in, and you just want to give up."

Students at most schools (five of eight) also generally liked the Frameworks course and the opportunities it provided to expand their understanding of their own learning, study skills, and the services the college provided. One student said, "I like that we got in groups and had to search out all the access [to resources] we had as students in the college. It helped us to know where's what, who to talk to." Others appreciated the learning-specific topics, such as lessons related to time management or learning styles. Students who didn't like the Frameworks course generally felt that the course taught them about concepts they already knew and that the course shouldn't be mandatory for all students. Students at a few colleges also didn't see how the Frameworks course connected with Foundations (though they were aware that the courses were supposed to be linked).

## **Spring 2014: Implementation of the Statistical Reasoning Course**

The NMP Statistical Reasoning course was the first college-level pathway course that the Dana Center developed among the three pathways. The course was aimed toward general education and social sciences students and was intended to be offered as a four-credit course, with an option to cut the course to three credits with the removal of some topics. The Statistical Reasoning course curriculum was organized around broad statistical content, with a focus on developing students' knowledge of one-variable and bivariate data, probability, categorical data, confidence, hypothesis testing, and chi-square testing. (Box 3.3 presents a sample Statistical Reasoning lesson.) The course met all requirements of the Texas Academic Course Guideline Manual for a college-level statistics course, meaning that it should be transferable from two-year to four-year colleges. As with Foundations, the Statistical Reasoning course was focused on active learning, with students doing the work to analyze statistical data and construct and test hypotheses while learning key statistical concepts.<sup>9</sup>

The Dana Center worked with incoming statistics teachers during fall 2013, offering an in-person training for faculty members slated to teach the Statistical Reasoning course as well as online webinars. Unfortunately, due to development issues, the Dana Center released the curriculum to faculty members in three separate batches during the spring semester while they were teaching the course. Faculty members implementing the Statistical Reasoning courses were asked to closely follow and give feedback on the curriculum. The Dana Center planned to develop a revised version of the curriculum during fall and summer 2014 based on their feedback.

### **Lessons from the Field**

Due in part to low enrollment in Foundations in the fall, most colleges had relatively low enrollments in their NMP Statistical Reasoning courses in spring 2014. Six of the seven colleges that offered Foundations in fall 2013 offered the NMP Statistical Reasoning course in spring 2014, though they generally offered only one section of the course; one of the six also offered its own internally developed statistics course, allowing successful Foundations students to enroll in either course at their discretion. The seventh college that implemented the Foundations course was unable to fill the spring NMP statistics course and placed students in its traditional statistics courses instead. The codevelopment college that had offered its own prestatistics course instead of Foundations also offered its own statistics courses.

Despite these challenges with Statistical Reasoning enrollments, three of the seven codevelopment colleges that implemented both Foundations and Frameworks in fall 2013 offered these courses again in spring 2014, with two colleges offering more sections in spring than

---

<sup>9</sup>Charles A. Dana Center (2014f).

### Box 3.3

#### **A Sample Statistical Reasoning Lesson: Designing Experiments**

This lesson builds on previous lessons in which students have been learning broadly about the statistical analysis process and different sampling methods in preparation for learning more sophisticated statistical methods, such as determining Z-scores. In this five-part lesson, students explore the concept of random assignment and discover the purpose of including a control group in an experiment. Key goals for this lesson are for students to understand the importance of controlling for extraneous variables in experiments, with specific focus on random assignment; to understand when conclusions can be drawn from a study; and to learn how to form and conduct an effective study group.

Based on prework in which students identified the treatment and response variables in two different experiments, the instructor breaks students into groups to list factors besides the treatment variables that could affect the response variables in the two studies (which are focused on food coloring's effect on soda preferences and methods for reducing bacteria after handling raw chicken). Students share their thoughts with the class, after which the instructor defines the nontreatment variables as "extraneous factors" and has students brainstorm methods for controlling these issues.

Students are then asked to design an experiment that tests two methods for surgically repairing a hernia. Using a chart that lists each subject's study number and age, students work in pairs to try out two different methods of random assignment, such as a coin toss or drawing subject numbers out of a hat. Students are asked to create age dot plots of the groups, calculate the average age for each of the dot plots, and then compare the dot plots with those of other pairs. The instructor asks the students to compare the success of each method in creating groups of students with similar characteristics, noting that the key goal is to make all experimental groups as similar as possible with respect to extraneous factors.

The instructor then moves the discussion toward a deeper understanding of control groups, blinding, and placebos. The teacher and students discuss a medical experiment in which doctors drilled holes into the brains of patients with Parkinson's disease and gave cell implants to some but not all of the patients. In small groups, students talk about why the surgeons did this, followed by a group discussion facilitated by the instructor. Students then pair off to work on an exercise related to a double-blind test of hiking boots. After the pairs have worked through several questions outlined in their materials, the instructor facilitates a group discussion, highlighting the importance of blinding in experiments and when this method can and cannot be used.

(continued)

### **Box 3.3 (continued)**

The teacher concludes the lesson by guiding students through the process of assessing a claim within samples versus within a larger population, which incorporates the key points from the previous lessons. Students are divided into small groups and asked to assess the differences between the sample population and the general population with two different studies: one analyzing women's preferences for the gender of an unborn child and another analyzing the impact fonts have on perceptions of task difficulty. Students compare dot plots of various characteristics of random samples from the general population with those from the sample participants and answer questions that are designed to lead them to conclude that the sample participants are most likely different from the general population. Through a group discussion, the instructor underscores that the random assignment process helps determine whether there is strong evidence against a random chance explanation for difference in a sample population. The instructor ends the lesson by facilitating a discussion around the pros and cons of study groups and guidelines for establishing these groups with other students.

they had in the fall. In addition, the one college that had been unable to start the Foundations and Frameworks courses in fall 2013 offered one section of each of these courses in spring 2014. This movement toward spring implementation of Foundations and Frameworks was above and beyond the Dana Center's original expectations for codevelopment colleges.

As in fall 2013, MDRC researchers noted a high level of fidelity to the NMP curriculum in observations of the Statistical Reasoning courses. Faculty members at almost all of the colleges were using the Dana Center curriculum and focused on the key topics underscored in these lessons, such as proportions and sampling variability. They were frequently observed breaking students into small groups and allowing them to collaborate on problems or questions together before sharing their observations or conclusions with the class. As in Foundations and Frameworks courses, students were highly interactive in the classes, which was in sharp contrast to the more lecture-based non-NMP statistics courses.

### **The Faculty Perspective on Statistical Reasoning**

Faculty members' responses to the NMP Statistical Reasoning course were mixed, with about half the instructors praising the curriculum for its approach and content and others concerned that it did not provide enough support for their students' math learning. As with the Foundations course, instructors appreciated the focus on the conceptual understanding of math and math learning in real-life contexts. As one instructor said, the Statistical Reasoning course "really dives into the concepts and gives [students] a true understanding of" statistics. Others

pointed out that the real-world examples helped students to engage more in their math learning and to feel like they're getting something valuable out of the course.

But like the fall 2013 instructors, spring 2014 faculty members raised concerns related both to the NMP course content and to the pressure they felt in implementing a new course under development. As with Foundations faculty, they reported having to spend a lot of time preparing to implement the courses, and nearly all were frustrated by the delayed release of the course materials. As one instructor stated, "I'm teaching this class starting in January, and I don't even get the full curriculum. It's [going to] come out in phases throughout the semester. ... As an instructor, you want your curriculum." Faculty at all campuses continued to express frustration with the technology component that was meant to accompany the course, and only one instructor continued trying to use the platform throughout the semester.

Faculty members at about half the colleges also noted concerns about the course content. Those at two of the three colleges that did not implement the Statistical Reasoning course were worried that the course was too scripted or that it was not rigorous enough. Instructors at three of the six colleges that did implement the course also raised questions about the content, wondering whether the NMP courses provided enough math content for students to be successful in their later courses. Because of these concerns, faculty members at about one-third of the colleges were unsure whether they would continue using the Dana Center-developed curriculum in the future, with many suggesting that they might alter it in significant ways to address its perceived inadequacies.

### **Student Responses to Statistical Reasoning**

Overall, students enrolled in Statistical Reasoning classes were positive about the courses and appreciative of the content and approach. As with Foundations, they continued to like the real-world applications, with many students arguing that this made math much easier to learn than in their previous courses. Students liked that there were multiple methods taught to answer a problem and that several examples were often used to explain a particular concept. As one student described it, "When there's more of one way of saying the same thing, it puts it in long-term memory. ... Maybe you've struggled coming to that conclusion, and you ask, 'How did you do that?' and then you're like, 'Oh! That's *way* easier.'" Most students also appreciated the group work, noting that they had "a good support group" or that they often studied together outside of class. Many students also talked about how excited they were to be completing their college-level math requirement.

When students had complaints about the course, they were often related to their perception of how their teacher was feeling about it. For instance, one student argued that the course developers were "rushing her [the teacher], and if she's falling behind, she feels pressured to catch up. It's not her fault. ... She just has so much to cover — we have to rush through every-

thing.” A few students also noted the challenges with the slow rollout of the course and the difficulty of keeping up with the different course documents without a textbook.

By the end of the year, however, students in the NMP statistics classes at most of the colleges felt positive about the course and said they would recommend it to a friend. In the words of one student, “I’ve already told someone ... it’s more useful.” Students at other colleges had similar thoughts, noting, “If a student has ever struggled with math in the past ... this would be a great class to take. ... If people think that they need an extra push or more understanding ... I definitely recommend it. For people like me ... I recommend it.”

## **Summary**

Overall, the codevelopment colleges made good progress in piloting and implementing the NMP courses during the 2013-2014 academic year. Students and faculty both appreciated the different approach of the courses, particularly the curricula’s focus on real-world content that helped students see the relevance of math for their own lives. By the end of the year, many NMP students stated that they would recommend the course sequence to a friend. Perhaps the most difficult issue raised with the NMP courses was faculty members’ perception that the curricula were not as rigorous as their own developmental math or statistics courses. In many cases, these concerns were related to the absence of algebra content, as some instructors felt that students would need these skills in their future classes or careers. Nonetheless, as discussed in the next chapter, many Foundations students who took either an NMP or a non-NMP statistics class in spring 2014 did succeed in passing this college-level course. Whether this beginning achievement will be translated into success throughout their college careers remains to be seen; this is something that MDRC researchers intend to track in future studies of the NMP.



## Chapter 4

# Student Developmental Math Outcomes

*I'll also say, I really think pre-stats is a lot harder than stats. I don't know if that's me — because I'm dumb when it comes to math — or did I learn so much from last semester that it seems easier for me this semester? I can't really tell you either or, but to me, it just seems like it's a whole lot easier. A whole lot easier. — Jenny*

*When you're looking at students coming in having to do developmental work, they have taken this material before, and in the case of mathematics, sometimes many, many times before. So if we're just offering a rehash of what they've experienced previously in school, why would we expect the outcome to be any different? — Myra Snell, professor of mathematics, Los Medanos College<sup>1</sup>*

Jenny appears again in spring 2014, where she is part of a focus group of students taking the New Mathways Project (NMP) Statistical Reasoning class. Somewhat to her own amazement, she passed the Foundations course. “I passed it, and I did it fast. And I was able to understand and process it!” She is now in the college-level statistics class and feeling good about it. As she mentions above, she finds the statistics class to be a lot easier than the Foundations course she took the previous semester. She seems much more hopeful that she will pass this class than she was about Foundations, pointing toward a growing level of confidence in her own math abilities.

As described in Chapter 1, the NMP is intended to improve academic outcomes for students enrolled in developmental math, including the rate at which students pass developmental math classes, complete their developmental math requirements, and enroll in and pass a college-level math course. This chapter describes the prevalence of developmental math needs and historical rates of success in developmental math at eight of the nine codevelopment colleges that worked with the Dana Center to implement the NMP beginning in fall 2013.<sup>2</sup> It also summarizes descriptive outcomes for students who enrolled in NMP courses during the 2013-2014 academic year, along with corresponding outcomes for students enrolled in traditional developmental math courses during the same period. The key findings from this chapter are:

---

<sup>1</sup>Snell (2010).

<sup>2</sup>Student-level data were not available for Alamo-Northwest Vista College; this college is not included in analyses presented in this chapter.

- As at many community colleges across the country, nearly half the students at Texas community colleges, including the codevelopment colleges, arrive at school with one or more developmental math needs and are required to pass developmental math courses before taking college-level math.
- Fewer than 20 percent of first-time-in-college students recommended for developmental education courses in Texas complete a college-level math course with a grade of “C” or better within three years of enrolling in college.
- Over 60 percent of students enrolled in the NMP Foundations course in fall 2013 successfully completed the course, and 30 percent of Foundations students successfully completed a college-level statistics course, primarily NMP Statistical Reasoning, by the end of spring 2014. Additional research is needed to estimate the effects of the NMP on these student outcomes.

## **Mirroring the Nation: A Picture of Remedial Need in Texas Community Colleges**

While few large-scale studies of developmental math needs among community college students have been conducted, research suggests that developmental math needs are pervasive among first-year community college students. One study of more than 250,000 first-year students enrolled in 57 colleges across seven states found that 59 percent of these students were referred to developmental math.<sup>3</sup> The same study also found that these students faced a low likelihood of success in developmental math courses: Only one in three students with developmental math needs had completed his or her developmental math requirements three years after initial enrollment in college.

In Texas, students’ developmental education needs are assessed upon entry into college through developmental education placement exams in reading, writing, and math.<sup>4</sup> Those who score above established cutoff levels in particular domains are assessed as having no remedial needs in those areas — also known as being “TSI (Texas Success Initiative) complete” in reading, math, or writing. Students assessed as having remedial needs are required to take a series of

---

<sup>3</sup>Bailey, Jeong, and Cho (2009).

<sup>4</sup>Before fall 2013, Texas community colleges used a variety of placement tests, such as ACT Compass and ACCUPLACER, to determine students’ level of need and college readiness. Beginning with the fall 2013 semester, the Texas Higher Education Coordinating Board introduced a new TSI placement exam with standard cutoff scores to determine whether students are college ready in math, reading, and writing. Placement scores from older tests may also still be used for placement. See Texas Higher Education Coordinating Board (2013) for more details.

developmental education courses in order to become TSI complete.<sup>5</sup> The number of courses required varies according to students' placement score and the college they attend. Most colleges have traditionally had a series of three or four developmental math courses, with students being placed within this course sequence based on the extent of their need. Students placed in courses two, three, or four levels below college level must complete each developmental level successfully before entering the next course in the series. Once students have successfully completed the full series of developmental courses, they are deemed TSI complete and are eligible to enroll in college-level courses.<sup>6</sup>

The Texas Higher Education Coordinating Board (THECB), the leadership and coordinating entity for Texas higher education systems, publishes reports summarizing enrollment, degree attainment, and other outcomes among Texas community college students. One area that the THECB examines is the overall proportion of students entering Texas community colleges with remedial needs and their progress through developmental education. As Table 4.1 shows, for the fall 2009 cohort, approximately 47 percent of first-time-in-college (FTIC) students were assessed as having some level of developmental math need.<sup>7</sup> THECB data also indicate that few students with developmental math needs successfully completed a college-level math course with a grade of "C" or better — after three years, fewer than 18 percent of these students had done so.<sup>8</sup> These numbers illustrate that Texas community colleges face challenges similar to those of colleges in other states: A large proportion of entering students require remediation before they can enroll in college-level math classes, but many of these students fail to make much progress through their developmental courses.

---

<sup>5</sup>The definition of "TSI complete" can vary over time and between colleges — staff members at one NMP codevelopment site explained that students at their school used to be considered TSI complete when the students reached their final developmental math course, rather than when they reached college-level math. This policy has since been changed. The new TSI placement test and cutoff scores, implemented in fall 2013, impose statewide standards for determining college readiness.

<sup>6</sup>Texas Higher Education Coordinating Board (2013, 2014b).

<sup>7</sup>THECB accountability system data, as reported in January 2014, for the most recent cohort at the time of writing. In addition to students assessed as having some level of developmental need, approximately 6 percent of students have an "unknown" level of need, both generally and with regard to math specifically. This group includes students, such as military veterans, for whom TSI developmental requirements have been waived or exempted. These students are not required to take developmental classes.

<sup>8</sup>The THECB measures success in college-level math according to the proportion of students who pass with a grade of "C" or better. Many of the codevelopment colleges also require students to achieve a grade of "C" or better in order to advance within their developmental sequence or to complete their final developmental course. The analyses presented in this chapter therefore use only grades of "C" or better when calculating the proportion of students who passed courses.

## The New Mathways Project

**Table 4.1**

### Fall 2009 Cohort Developmental Math Needs and Progress at Texas Community Colleges

Outcome	Value
Fall 2009 first-time-in-college (FTIC) students	111,939
Fall 2009 FTIC students not TSI complete in math	
Number of students	52,344
Percentage of all fall 2009 FTIC students	46.8
Fall 2009 FTIC students not TSI complete in math who went on to pass a college-level math course with a “C” or better within 3 years	
Number of students	9,157
Percentage of fall 2009 FTIC students not TSI complete in math	17.5

SOURCE: Texas Higher Education Coordinating Board accountability system data, as reported in January 2014.

NOTE: TSI = Texas Success Initiative.

## Developmental Math Progress at the NMP Codevelopment Colleges

Student-level data from eight NMP codevelopment colleges reveal a picture similar to that at other Texas community colleges and the country as a whole. MDRC researchers analyzed student-level data to estimate the number of students who were not TSI complete in math, the number of students who enrolled in a developmental math course each semester, and the number who passed the course with a grade of “C” or better at these eight codevelopment colleges.<sup>9</sup> These data, summarized in Table 4.2, show that only a small proportion of students at the codevelopment colleges made progress with their developmental math requirements each semester.

Data were examined for the fall 2011 through spring 2014 semesters. A total of approximately 23,000 to 30,000 students who were not TSI complete in math enrolled at the eight colleges each semester. In most semesters, slightly more than half these students enrolled in developmental math classes, and 24 percent to 28 percent passed such a class with a grade of “C” or

---

<sup>9</sup>For this and other student-level analyses presented in this chapter, copies of the reports provided to the THECB were obtained from these eight schools, including data on students’ placement test scores, their TSI status (for example, complete, exempt, waived), the courses that they enrolled in, their grades, and other measures.

## The New Mathways Project

**Table 4.2**

### **Developmental Math Enrollment and Pass Rates at Codevelopment Colleges, Fall 2011 Through Spring 2014**

Semester	Students Not TSI Complete <sup>a</sup>	Enrolled in Dev Math		Passed Dev Math <sup>b</sup>	
		Number	Percentage	Number	Percentage
Fall 2011	30,294	16,474	54.4	7,853	25.9
Spring 2012	28,125	14,782	52.6	6,985	24.8
Fall 2012	29,675	15,727	53.0	8,231	27.7
Spring 2013	26,043	13,680	52.5	6,854	26.3
Fall 2013	26,266	13,777	52.5	7,340	27.9
Spring 2014	23,611	11,425	48.4	5,739	24.3

SOURCES: MDRC calculations using college transcript and placement test data.

NOTES: Summer semesters are not shown. Students who enrolled in NMP Foundations courses are not included.

<sup>a</sup>Includes all students except those who were TSI complete, waived, or exempt in math.

<sup>b</sup>Passed values include only students who passed with a grade of “C” or higher.

better, the grade required by many of the colleges in order to move to the next developmental math course in the sequence or complete the final course in the sequence. This means that approximately 70 percent to 75 percent of students assessed as in need of developmental math did not complete a developmental math course each semester. Thus students who face multiple required remedial math classes had a low likelihood of completing all the developmental classes they were required to take.

### **Student Success in NMP and Non-NMP Courses: Developmental and College-Level Math Outcomes in 2013-2014**

The NMP is intended to help students progress through developmental math and increase the rates at which they enroll and succeed in college-level math. The program was designed for students who are required to complete one or two developmental classes before taking college-level math, also referred to as being “one or two levels down” from college math. The Dana Center’s design recommended that NMP students be enrolled in Foundations and Frameworks courses in the fall semester and enrolled in Statistical Reasoning in the spring semester (assuming successful completion of Foundations). However, as described in Chapters 2 and 3, there was variation in codevelopment colleges’ implementation of the NMP. Some colleges did not

pair Foundations and Frameworks; others did not offer the Statistical Reasoning course; and others did not implement either Foundations or Statistical Reasoning in 2013-2014. In addition, many schools had difficulty enrolling students into the NMP courses. Given this, NMP recruitment at some colleges was not limited to students with one or two levels of developmental math need. Staff members at two codevelopment sites told MDRC that NMP classes at their schools enrolled a number of TSI-complete students who took Foundations as a “refresher course” despite having already satisfied all developmental math requirements. Colleges may also have recruited students with three or more levels of developmental math need for NMP courses. And in a few instances, students enrolled in Statistical Reasoning without having previously enrolled in Foundations.

This section summarizes the enrollment and success rates of students in NMP courses as well as those enrolled in traditional developmental math courses. Student data were examined for the fall 2013 and spring 2014 semesters, during the first implementation of the Statistical Reasoning pathway. This section describes the proportion of students enrolled in NMP and traditional developmental math courses in fall 2013 who met various milestones by the end of the spring 2014 semester, including completing their developmental math requirements, enrolling in a college-level math course, and passing a college-level math course.<sup>10</sup> Because of variations in colleges’ assessments, cutoff scores, and other data used to assign students to a particular developmental level, the summaries presented here focus only on students who actually enrolled in a developmental math course, either NMP or traditional, in the fall 2013 semester. Other students with some level of developmental math need who did not enroll in a course are not included in these summaries; many of these students likely made little to no progress in developmental math during the 2013-2014 year.

### **Students Enrolled in Traditional Developmental Math Courses**

Approximately 16,000 students enrolled in traditional developmental math classes at the eight codevelopment colleges during the fall 2013 semester. This group was relatively evenly divided among students who enrolled in developmental courses one, two, or three levels down from college-level math, with approximately 5,000 students enrolling at each level. While many of the students who enrolled one level down in fall had completed their developmental requirements by the end of the spring 2014 semester, fewer of the students two and three levels down

---

<sup>10</sup>In addition to traditional, three-course developmental math sequences, many of the colleges offered other, non-NMP alternatives to developmental math, including modular sequences, hybrid developmental-and-college-level courses, and alternate accelerated math pathways. Analysis of THECB data shows that among non-NMP students, approximately 87.5 percent of students who enrolled in a developmental math course during the fall 2013 semester enrolled in a traditional class. This analysis focuses only on each college’s primary, traditional, three-course math sequence when discussing outcomes among non-NMP students.

had done the same. This result is not unexpected, especially for students with three remedial math needs, given that they required a greater number of developmental math classes in order to reach the same milestones as the “one level down” group. Table 4.3 summarizes these results.

Students who enrolled in a traditional developmental math class one level down are shown in the first column of the table. By the end of the spring 2014 semester, 60 percent of these students had passed their developmental class, fulfilling their developmental math requirements. These results are similar to the values shown in Table 4.2 — approximately half the students who enrolled in the developmental class passed it. Of the original group who had enrolled in developmental math, 37 percent enrolled in a college-level math class and 23 percent passed the college-level math class by the end of the spring semester.

The second and third columns of Table 4.3 show the same outcomes for the students who enrolled in developmental classes two or three levels down from college-level math in fall 2013. By the end of the spring semester, only 18 percent of students in the “two levels down” group had completed their developmental math requirements, while fewer than 5 percent had enrolled in or passed a college-level course. Among students in the “three levels down” group, only 1 percent to 2 percent of students had achieved each milestone.

The final column of the table shows overall results for all students who enrolled in a traditional math class, whether one, two, or three levels down. Approximately 25 percent of students completed their developmental math requirements, 14 percent enrolled in a college-level math class, and slightly more than 8 percent passed a college-level math class.

### **Students Enrolled in NMP Courses**

In fall 2013, 233 students enrolled in NMP Foundations across the seven codevelopment colleges that offered the courses.<sup>11</sup> These students were more likely to attain each of the developmental milestones than students who had enrolled in traditional developmental math courses during the same semester. Table 4.4 shows the rates at which students who had enrolled in Foundations completed their developmental requirements, enrolled in Statistical Reasoning or another college-level statistics course, and passed Statistical Reasoning or another college-level statistics course. As shown in the first column of the Table 4.4, almost 65 percent of these students passed Foundations, thereby fulfilling their developmental math requirements.<sup>12</sup> By the

---

<sup>11</sup>Of the eight colleges for which student-level data were available, only seven colleges offered Foundations courses in fall 2013. The eighth college was unable to enroll enough students in fall 2013 to offer the course.

<sup>12</sup>In the summer of 2014, the THECB revised TSI standards to allow students who pass NMP Foundations to be counted as having completed their TSI developmental math requirements for nonalgebra pathways. See Charles A. Dana Center (2014i).

**The New Mathways Project**

**Table 4.3**

**Math Outcomes Among Students Enrolled in Traditional Developmental Math Courses at Codevelopment Colleges, Fall 2013 Through Spring 2014**

Outcome	Developmental Levels Down of Math Courses Enrolled In			
	One Level	Two Levels	Three Levels	All Students
Students enrolled in a traditional developmental math class in fall 2013	4,965	5,656	5,539	16,160
Among those enrolled in fall 2013 traditional developmental math class, by spring 2014 (%)				
Completed developmental math requirement <sup>a</sup>	59.7	18.3	1.7	25.3
Enrolled in a non-NMP college-level math class	36.5	4.8	2.3	13.7
Passed non-NMP college-level math class with “C” or higher	22.7	2.6	1.0	8.3

SOURCE: MDRC calculations using college transcript data.

NOTES: Students enrolled in NMP Foundations or enrolled in both college-level math and any type of developmental math in the same semester are excluded from the numbers above. Among the remaining developmental math students, approximately 12.5 percent were enrolled in a nontraditional developmental math class (such as a modular or accelerated course). These students are not shown above.

Students included in this table are shown on the basis of the course they enrolled in, not on their developmental need or placement test score. Table may include some students who were TSI complete in math but chose to take developmental math classes.

<sup>a</sup>Completion of the developmental math requirement is defined here as passing a traditional developmental math class one level below college level with a grade of “C” or higher.



**The New Mathways Project**

**Table 4.4**

**Math Outcomes Among Students Enrolled in NMP Foundations at Codevelopment Colleges,  
Fall 2013 Through Spring 2014**

Outcome	All Colleges Offering Foundations <sup>a</sup>	Colleges Offering Foundations That Promoted Enrollment in Statistical Reasoning <sup>b</sup>
Number of codevelopment colleges	7	5
Students enrolled in Foundations in fall 2013	233	136
Among students enrolled in fall 2013 Foundations, by spring 2014 (%):		
Passed Foundations with “C” or higher	64.8	69.9
Enrolled in Statistical Reasoning or other college-level statistics course	45.5	64.0
Passed Statistical Reasoning or other college-level statistics course with “C” or higher	30.0	48.5

SOURCE: MDRC calculations using college transcript data.

NOTES: <sup>a</sup>One codevelopment college did not offer Foundations in fall 2013.

<sup>b</sup>At five of the codevelopment colleges, students who were in Foundations in fall 2013 were encouraged to register for Statistical Reasoning in spring 2014. At the two remaining colleges, either Statistical Reasoning was not offered or students enrolled in Foundations were not encouraged more than other, non-NMP students to register for Statistical Reasoning.

end of the spring 2014 semester, 46 percent of the Foundations students had enrolled in Statistical Reasoning or another college-level statistics course and 30 percent had passed it.

These results include a small number of instances where students enrolled in a college-level statistics course other than the NMP's Statistical Reasoning. This is intended to more completely capture student math enrollment and achievement at two colleges where either Statistical Reasoning was not offered or Foundations students were not specifically encouraged to enroll in the NMP course.<sup>13</sup>

The second column of Table 4.4 illustrates results for the subset of five codevelopment colleges where staff members encouraged students who had completed Foundations to enroll in Statistical Reasoning, according to the original design of NMP. Among this subset of colleges, nearly 50 percent of the students who initially enrolled in Foundations in fall 2013 had completed Statistical Reasoning or another college-level statistics course by the end of the spring semester. This higher proportion (almost 50 percent compared with 30 percent among all colleges offering Foundations) suggests that students' likelihood of passing Statistical Reasoning or another college-level statistics course may depend in large part on whether colleges promote enrollment in Statistical Reasoning.

Overall, these results compare favorably against the outcomes shown in Table 4.3 for students enrolled in traditional developmental math courses. However, care should be taken when drawing comparisons between the two tables, for a variety of reasons discussed in further detail below.

## Summary

As at other colleges around the country, many students at the codevelopment colleges are required to pass developmental math courses before they are allowed to enroll in college-level math. Rates of developmental success have historically been low, and many Texas community college students do not complete their developmental requirements in a timely fashion. A descriptive summary of outcomes for students enrolled in NMP and traditional developmental math classes during the 2013-2014 academic year shows that students enrolled in NMP courses were more likely to meet developmental math milestones, including completing their developmental requirements and enrolling in and passing a college-level math class (primarily Statistical Reasoning for students enrolled in Foundations). Among other factors, the accelerated nature of the NMP and the encouragement that many schools provided to students eligible to en-

---

<sup>13</sup>At this latter college, two college-level statistics courses were available. These courses were not distinguished in the course catalogue and thus students who passed the Foundations course could enroll in either the NMP statistics course or the college's own college-level statistics course.

roll in Statistical Reasoning may help NMP students make progress in developmental math and complete a college-level math course.

But care should be taken when interpreting the outcomes presented in this chapter. Because these analyses only summarize student data and do not control for other potentially confounding factors, differences in outcomes between students who enrolled in NMP and those who enrolled in traditional developmental math courses are not directly attributable to the NMP program and cannot be interpreted as estimates of program effects. As discussed in Chapter 2, codevelopment colleges targeted the NMP program to particular students, placing a variety of restrictions on which types of students were eligible for the program. Differences in student outcomes may therefore be due in part to differences in the type of student who enrolled in the NMP compared with students who enrolled in other courses. Other factors, such as the characteristics of the faculty who taught NMP courses compared with faculty who taught other math courses, may also contribute to differences in outcomes. Given the limited number of students who enrolled in the NMP during the 2013-2014 year, results may also reflect some degree of variability and chance — if a similar set of students enrolled in the NMP in the fall 2014 semester, their outcomes could be better or worse than the results shown here due to random variation. Different levels of developmental need between students who enrolled in traditional developmental classes and those who enrolled in NMP Foundations courses may also have affected outcomes. As discussed previously, staff at two codevelopment colleges have said that NMP courses at their schools enrolled some students without any developmental math needs. Further work is needed to better understand these issues.

MDRC plans to undertake additional research to more rigorously evaluate the effects of enrollment in NMP classes. Through funding from the Institute of Education Sciences, a randomized controlled trial of the NMP will be one of the primary projects conducted within the new Center for the Analysis of Postsecondary Readiness, a federally funded center focused on evaluating the promise of new developmental education assessment and instructional reforms. This analysis will seek to address many of the issues noted and provide a causal estimate of the NMP's effects on student outcomes.



## Chapter 5

# Moving Beyond the Institution: Implications for Policy and Practice from a Statewide Perspective

*This was supposed to be my last math class, but now that I'm going into the bachelor's program, I need to take another one. ... But, hey, that's okay — I'd rather do two than the five I was going to have to take. — Jenny*

*Basic structural change is going to take place, and unless policymakers, foundations, and most important the math leadership — big tent, broad, diverse thinking — are involved in this, we'll have myriad students trapped in college algebra courses, trapped in front of computers and pressing buttons for skills that are irrelevant to the workplace. ... Our students will not be the beneficiaries of that work. ... This is a time to look at statewide reform. — Uri Treisman, executive director of the Charles A. Dana Center<sup>1</sup>*

During MDRC's spring 2014 focus groups, Jenny mentions almost immediately that she has changed her major. She has decided to move on to a bachelor's degree in business when she finishes her associate's degree. Along with this decision came the news that she would be required to take another math class for entry into this program. However, surprisingly, Jenny has taken this news in stride. Unlike the scared and intimidated developmental math student of fall 2013, she shrugs her shoulder: "It's okay." Rather than trying to shy away from any more math courses, she seems ready to take on the challenge — and feels fairly confident that she will succeed.

For Jenny as well as dozens of other students at the codevelopment colleges, the New Mathways Project (NMP) has changed math learning. In focus groups with MDRC researchers, many students explained how math looked and felt different from the way it had before. Like Jenny, most of the students were surprised by how relevant math could be to their lives and how they could more critically evaluate everyday quantitative information, such as sales promotions and targeted advertisements. Many had started in the NMP classes feeling they could never grasp math, and many left much like Jenny, more confident in their ability to approach the quantitative issues that they face in their everyday lives.

This change in students' perspectives amounts to a powerful statement about the Dana Center's efforts to bring the NMP to Texas. In the short amount of time between spring 2012

---

<sup>1</sup>Treisman (2014), minute 40:20.

and spring 2014, the Dana Center was able to build support for the NMP and partner with the Texas Association of Community Colleges (TACC) in adopting it in Texas, resulting in all 50 Texas community college system presidents and CEOs agreeing to fund a long-term initiative focused on making math pathways the norm in Texas. In addition, the Dana Center and TACC were able to garner millions to support the development of the NMP, including a \$2.4 million legislative appropriation from the state of Texas, a nearly unheard-of event for a community college initiative. By December 2012, 47 of 50 Texas community college districts were enrolled and engaged with the project, with a diverse group of nine colleges serving as codevelopment partners. (See Figure 1.2 in Chapter 1.)

Beginning in summer 2012, the Dana Center began developing the courses, trainings, and materials to support the NMP's implementation and recruited nine colleges to assist it in this process. By fall 2013, eight of the nine colleges were implementing NMP courses, with over 500 students enrolling in NMP courses in the spring 2014 semester.<sup>2</sup> By the end of the year, over 60 percent of students in Foundations of Mathematical Reasoning had passed the course and completed their developmental education requirements, and more than 30 percent of students had successfully completed a college-level statistics course. By fall 2014, a total of 20 colleges were implementing an NMP pathway, representing approximately 40 percent of the Texas community college systems.<sup>3</sup>

Clearly, much progress has been made in building the NMP within Texas. But the Dana Center, TACC, and the Texas colleges still face a number of challenges in reaching the goal of having 25 percent to 50 percent of developmental math students in an NMP pathway within the next four years. As discussed in Chapters 2 and 3, many of the codevelopment colleges implemented only small pilots of the NMP courses, and the majority of schools remained hesitant to scale the NMP classes beyond this level in spring 2014. Their reluctance tended to stem from concerns about whether the NMP courses would be applicable to majors at four-year colleges and universities, an issue that, in their eyes, had not yet been resolved by spring 2014. Additionally, faculty members at about half the codevelopment colleges were ambivalent about the courses, with many concerned about the curricula and whether they could be implemented well in the community colleges throughout Texas. These problems are not insignificant and provide a good context for considering the work that the Dana Center, TACC, and the Texas colleges have ahead of them. This chapter examines the current barriers to the scaling of the NMP within Texas and beyond and provides recommendations for improvement on the road ahead.

---

<sup>2</sup>A total of 520 students (unduplicated) enrolled in Foundations, Frameworks, and Statistical Reasoning in spring 2014.

<sup>3</sup>Some college systems had more than one college campus implementing the NMP, so the count of college systems is slightly lower than the count of individual college institutions.

## Scaling the NMP: Overcoming Critical Challenges to Implementation

Scaling up has long been a challenge with reforms at all educational levels. Evaluations of several comprehensive reform initiatives, from preschool to community college, have revealed that intensive projects, such as those focused on changing classroom practices, are difficult to expand within and across schools and tend to reach only a few students within an institution.<sup>4</sup> Resources to train the faculty in a new reform and support its implementation are often scarce — particularly in community college settings, which rely heavily on cheaper adjunct, or part-time, faculty members to teach many of their developmental math courses.<sup>5</sup> And the teachers implementing new reforms, who are accustomed to being in charge of their own domain within the classroom, typically react negatively to externally developed interventions. They may adopt only certain elements of a more broad-ranging reform, often superficially, within their classrooms.<sup>6</sup> For these reasons, colleges and states have often been limited in their ability to make systematic changes to classroom practices without careful attention to the faculty members and local contexts that influence their implementation.<sup>7</sup>

The scaling of reforms in educational settings is often seen one-dimensionally, with the focus being on the numbers of students receiving a new intervention and the benefits they may have received. But analyses of new reforms — and their impact — also require careful attention to other dimensions of scale. As Cynthia Coburn points out in her analysis of school reform, scaling also requires careful attention to the depth at which a program has changed classroom practice, faculty and colleges' sense of ownership in its implementation, and the sustainability of the new reform over time.<sup>8</sup> Each of these dimensions, along with its spread to new students, plays a role in the expansion of a reform within and across institutions and its potential success in changing student outcomes.

The Dana Center, along with its college and TACC partners, has made good progress on a number of these dimensions. A high level of fidelity to the Dana Center curricula was seen in nearly all the NMP classrooms observed by MDRC researchers, and a clear contrast existed in the pedagogy and student interactions between NMP and non-NMP courses. Perhaps an even truer test is that students could clearly see the differences between their NMP courses and other

---

<sup>4</sup>Zachry Rutschow et al. (2011); Quint, Jaggars, Byndloss, and Magazinnik (2013); Cohen and Ball (2000).

<sup>5</sup>Fong and Visher (2013); Zachry Rutschow and Crary-Ross (2014); Jenkins (2011); Fain (2014).

<sup>6</sup>Elmore, Peterson, and McCarthy (1996); Tyack and Cuban (1997); Coburn (2003); Cuban (1993); Cohen and Ball (2000); Zachry Rutschow et al. (2011).

<sup>7</sup>Elmore, Peterson, and McCarthy (1996); Coburn (2003); Cohen and Ball (2000); Quint and Byndloss (2003).

<sup>8</sup>Coburn (2003).

courses they had taken previously. Also, faculty members at some colleges felt real ownership in the development and implementation of the NMP curricula, with many providing detailed feedback to the Dana Center for further revisions. Finally, the buy-in of the Texas colleges' leadership and the implementation of the NMP at 20 institutions indicate strong promise for the spread of the initiative.

The challenges colleges faced with recruiting students into the NMP courses and the relatively high level of concern many faculty had with NMP course curricula and implementation represent key areas for improvement for the initiative. The following section provides some suggestions and recommendations around Coburn's four principles of scaling for how the Dana Center, TACC, and the colleges might think forward about NMP's scaling up.

### **Shifting Toward Internal Ownership**

The faculty's sense of ownership over the NMP was perhaps the greatest challenge of the NMP's first year of implementation. At nearly half the colleges, faculty members perceived the NMP as an externally driven initiative over which they had little influence. These faculty members voiced concerns about NMP course content and saw the Dana Center as taking a top-down approach with its implementation, with some noting that they felt uncertain about whether their issues with the curricula could be heard. Although they had agreed to implement the NMP courses with fidelity as part of their codevelopment contract, a number of instructors were frustrated with their inability to adapt or modify the courses, particularly when they perceived that critical elements were missing from the curricula. Given these issues, faculty members at about half the colleges were unsure whether they would continue using the NMP course materials or scale the courses beyond their current pilot levels.

Though such difficulties are understandable — and common — among the first instructors to implement a reform,<sup>9</sup> this high level of frustration with the NMP courses signals clear challenges with faculty ownership of the initiative. The Dana Center's broader model for the NMP, which focuses more on the implementation of its four principles, as outlined in Chapter 1, than on course curricula, will likely help soften these objections in the coming years.<sup>10</sup> Still, more support may be required before faculty members see the NMP as an internal rather than an external reform. Two areas may need particular efforts: (1) building understanding of why the

---

<sup>9</sup>Coburn (2003).

<sup>10</sup>The four principles are (1) multiple math pathways with relevant and challenging content aligned with specific fields of study; (2) acceleration that allows students to complete a college-level math course more quickly than they would in the traditional developmental and college-level math sequence; (3) intentional use of strategies to help students develop skills as learners; and (4) curricular design and pedagogy based on proven practice.



content in NMP courses is different and may look less “rigorous”; and (2) building faculty’s voice and contributions to development of the initiative.

In approaching the first issue, the Dana Center and its partners could emphasize the reasoning behind the choice to cut some course content and focus on other skills they see as the most fundamental to students’ chosen careers. The Dana Center has developed some materials to clarify the sources for the NMP principles and course materials, including annotated bibliographies describing the research behind these tenets.<sup>11</sup> Yet these materials provide less information about why particular academic concepts are emphasized or deemphasized, information that could be helpful as faculty members attempt to understand why certain concepts are taught and others are not.

Open dialogue and more opportunities for faculty development might also help increase ownership of the initiative. One of the key things that faculty members called for in their interviews was more one-on-one interactions with each other and the Dana Center, opportunities they saw as fostering their ability to contribute to the strategic thinking about the NMP’s future. Sponsoring such regular interactions and encouraging further opportunities for faculty leadership, such as through coaching, negotiating policy issues, or helping foster the growth of the NMP at other institutions, might be places to start. Finally, making public faculty members’ key questions about the NMP and providing ways for these critiques to be part of the NMP development process might also help.

### **Depth of Implementation**

Although the codevelopment colleges closely followed the Dana Center’s curricula in the first year, the depth of colleges’ implementation of the NMP will likely be a central issue in the coming years. Faculty members’ questions about the curricula and suggestions that they might move away from strict adherence to the Dana Center model portend this situation. Anticipating future colleges’ greater latitude with the NMP, including the ability to brand their own internally developed courses as NMP courses, highlights the need to clearly define what the NMP is and what aspects of the reform are seen to be most central to students’ success.

As the Dana Center moves away from a focus on curricula and toward the broader definition of the NMP, it will be critical to delineate how the most important aspects of the NMP model can be seen in on-the-ground practice — and this could be a key area where faculty and others implementing the NMP might contribute. Research into the NMP model and efforts to document students’ success should also be centrally tied to understanding the depth of the NMP implementation at each school. Following Coburn’s point, in-depth research into the instruction

---

<sup>11</sup>For example, see Charles A. Dana Center (2014e).

and pedagogy of the NMP courses and assessment of the level of change the reform has brought to students' courses and course-taking will be critical to understanding whether and how the NMP may be helping students progress in math and college more generally.<sup>12</sup>

## **Spread**

While efforts to improve faculty ownership of the NMP and further delineation of the NMP model may help encourage the spread of the NMP, further work on two issues fundamental to student recruitment and enrollment are also in need of further attention. First, the lack of alignment — or perceived lack of alignment — between two-year and four-year colleges' math requirements and policies must be resolved if two-year colleges are to recommend these courses to additional students. The Dana Center has done an enormous amount of work on this issue over the past year, from developing materials outlining the math requirements of all public four-year colleges in Texas to fostering initial meetings between the NMP colleges and their four-year transfer institutions.<sup>13</sup> Yet despite this work, all but two codevelopment colleges still voiced concerns about the transfer of NMP courses to four-year institutions in spring 2014 and noted that they had been limiting the expansion of NMP courses as a result.

The codevelopment colleges' concerns are not unfounded. A small number of four-year institutions in Texas, such as the main campus of the University of Houston, still rely heavily on college algebra as the most applicable option for transfer students to satisfy the core math requirements for many majors.<sup>14</sup> However, this landscape is quickly changing, as most Texas four-year colleges are integrating nonalgebra courses, such as statistics and quantitative reasoning, into their core math requirements. No public universities in Texas still require college algebra or courses in the calculus sequence for every major, including the state's two flagship universities, University of Texas-Austin and Texas A&M-College Station. Both institutions accept at least one non-algebra-intensive college-level math course as fulfilling the math requirement of certain majors. In addition, as of fall 2014, most of the codevelopment colleges' transfer partners accept these courses, revealing that, at this point, two-year colleges' alignment concerns may be more about perception than reality.

Regardless, much more clearly needs to be done to foster the acceptance of non-algebra-intensive pathways at four-year colleges and educate two-year and four-year college faculty and staff about four-year colleges' policies. In some cases, this issue may be resolved through discussions between the institutions to clarify where alignment exists. In other cases,

---

<sup>12</sup>Coburn (2003).

<sup>13</sup>Charles A. Dana Center (2014c); Cullinane and Tow (2014a, 2014b); Cullinane, Carvalho, and Tow (2014a, 2014b).

<sup>14</sup>Charles A. Dana Center (2014b).

where the depth of concern is greater or less alignment exists, even more may be required, such as written contracts or memos of understanding between the schools that can assuage unconvinced staff members.

Two-year colleges and the Dana Center can also do more to educate advisers about the existence of multiple math pathways, both within their institution and across the state. A few colleges, such as Brazosport College, Austin Community College, and Alamo-Northwest Vista, have normalized recommendations for multiple math pathways into their advising process, with detailed flow charts describing which students and majors are eligible for the different pathways. These types of normative processes, and the tools they use, can serve as useful models for other colleges having difficulty institutionalizing the NMP within their schools.

### **Sustainability**

The sustainability of the NMP reform over time is yet to be seen, though good progress has been made for its growth within the state of Texas and beyond. By spring 2014, over half the codevelopment colleges were exploring ways to implement the next NMP pathway, Quantitative Reasoning, or expand their Statistical Reasoning offerings in fall 2014. In addition, the Dana Center has made inroads in other states for further expansion of the NMP, through their current work in Georgia and Ohio as well as a new partnership with Complete College America, which will bring the NMP principles and work to five additional states.<sup>15</sup> The implementation of NMP in Texas will likely be a laboratory of learning for a number of other states as they look to revise their college math pathways and improve the success of developmental education students.

Fortunately, the NMP's work and its effects will be a focal point of a new federally funded developmental education research center, the Center for the Analysis of Postsecondary Readiness (CAPR). Led by MDRC and the Community College Research Center, CAPR seeks to shed light on how recent reforms to developmental education instruction and assessment are affecting students' success in college. A rigorous assessment of the NMP, one of three core studies at CAPR, will examine many of the issues noted above, including the depth and spread of the NMP at selected schools and its effects on student outcomes.<sup>16</sup>

### **Summary**

Previously published data from the Texas Higher Education Coordinating Board (THECB) suggest that more than 80 percent of students who enter college with some level of remedial

---

<sup>15</sup>Charles A. Dana Center (2015).

<sup>16</sup>White House (2014).

math need will never complete a college math course with a grade of a “C” or better.<sup>17</sup> While the small proportion of Texas developmental math students who accomplished this goal might have had to figure out which of their community college classes would transfer to a four-year college or university, tens of thousands of others were unlikely to have ever had this luxury, as they were unable to complete a college-level math class in the first place. These statistics reveal the predicament facing developmental students such as Jenny: Far too few are succeeding in mastering math content that is often not needed in today’s careers. Developing new courses that better align with the math skills that are needed, and helping students understand the practical value of these skills, may be an important step toward improving their chances of success — both in college and beyond.

---

<sup>17</sup>THECB accountability system data, as reported in January 2014, for the most recent cohort at the time of writing. Table 4.1 of the present report shows these data.

**Appendix A**

**College Systems Implementing the NMP**



## The New Mathways Project

### Appendix Table A.1

#### List of College Systems Implementing the NMP

Codevelopment Colleges	Colleges Implementing in 2014	Colleges Implementing in 2015 or Later
Alamo College District <i>Northwest Vista</i>	Alamo College District <i>Palo Alto College</i>	Amarillo College
Austin Community College	Angelina College	Blinn College
Brazosport College	Coastal Bend College	Central Texas College
El Paso Community College	College of the Mainland	Clarendon College
Kilgore College	Dallas County Community College	Collin College
Lone Star College System <i>Kingwood</i>	System <i>Brookhaven College</i>	Del Mar College
Midland College	Grayson College	Frank Phillips College
South Texas College	McLennan Community College	Galveston College
Temple College	Navarro College	Hill College
	Northeast Texas Community College	Houston Community College System
	Paris Junior College	Howard College
	Ranger College	Lamar State College System <i>Orange</i>
	Southwest Texas Junior College	Lee College
	Trinity Valley Community College	Lone Star College System <i>Cy Fair</i>
	Victoria College	<i>Montgomery</i>
		<i>North Harris</i>
		<i>Tomball</i>
		<i>University Park</i>
		North Central Texas College
		Odessa College
		Panola College
		San Jacinto College
		South Plains College
		Tarrant County College District
		Texarkana College
		Texas Southmost College
		Tyler Junior College
		Vernon College
		Weatherford College
		Wharton County Junior College

SOURCE: Charles A. Dana Center.





## References

- Adams, Peter, Sarah Gearhart, Robert Miller, and Anne Roberts. 2009. "The Accelerated Learning Program: Throwing Open the Gates." *Journal of Basic Writing (CUNY)* 28, 2: 50-69.
- Bailey, Thomas. 2013. Interview by Stan Jones, Complete College America 2013 Annual Convening (October). Video. Website: [www.youtube.com/watch?v=2VPtsjroDjA](http://www.youtube.com/watch?v=2VPtsjroDjA).
- Bailey, Thomas, Dong Wook Jeong, and Sung-Woo Cho. 2009. "Referral, Enrollment, and Completion in Developmental Education Sequences in Community Colleges." *Achieving the Dream: Community Colleges County Initiative Paper*. New York: Community College Research Center.
- Barker, William, David Bressoud, Susanna Epp, Susan Ganter, Bill Haver, and Harriet Pollatsek. 2004. *CUPM Curriculum Guide, 2004: Undergraduate Programs and Courses in the Mathematical Sciences*. Washington, DC: Mathematical Association of America. Website: [www.maa.org](http://www.maa.org).
- Barnett, Elisabeth A., Rachel Hare Bork, Alexander K. Mayer, Joshua Pretlow, Heather D. Wathington, and Madeline Joy Weiss. 2012. *Bridging the Gap: An Impact Study of Eight Developmental Summer Bridge Programs in Texas*. New York: National Center for Postsecondary Research.
- Biswas, Radha Roy. 2007. "Accelerating Remedial Math Education: How Institutional Innovation and State Policy Interact." *Achieving the Dream Policy Brief*. Boston: Jobs for the Future.
- Charles A. Dana Center. 2013. "Foundations of Mathematical Reasoning: Curriculum Overview." Website: [www.utdanacenter.org/wp-content/uploads/NMP\\_FMR\\_overview\\_and\\_learning\\_outcomes\\_Sept2013.pdf](http://www.utdanacenter.org/wp-content/uploads/NMP_FMR_overview_and_learning_outcomes_Sept2013.pdf).
- Charles A. Dana Center. 2014a. "Frameworks for Mathematics and Collegiate Learning," version 2.0. Austin: The University of Texas at Austin. Website: [www.utdanacenter.org/downloads/new\\_mathways\\_project/NMP\\_frameworks\\_course\\_v2.0\\_with\\_updates.pdf](http://www.utdanacenter.org/downloads/new_mathways_project/NMP_frameworks_course_v2.0_with_updates.pdf).
- Charles A. Dana Center. 2014b. "Frameworks for Mathematics and Collegiate Learning: Selected Supporting Research." Website: [www.utdanacenter.org/wp-content/uploads/nmp\\_frameworks\\_annotated\\_bibliography\\_2014june18.pdf](http://www.utdanacenter.org/wp-content/uploads/nmp_frameworks_annotated_bibliography_2014june18.pdf).
- Charles A. Dana Center. 2014c. "Mathematics Pathways Transfer Inventory." Austin: University of Texas at Austin.
- Charles A. Dana Center. 2014d. "The New Mathways Project Curricular Materials." Website: [www.utdanacenter.org/higher-education/new-mathways-project/new-mathways-project-curricular-materials/](http://www.utdanacenter.org/higher-education/new-mathways-project/new-mathways-project-curricular-materials/).

- Charles A. Dana Center. 2014e. "The New Mathways Project's Four Guiding Principles: Selected Supporting Research." Website: [www.utdanacenter.org/wp-content/uploads/nmp\\_guiding\\_principles\\_annotated\\_bibliography\\_2014june23.pdf](http://www.utdanacenter.org/wp-content/uploads/nmp_guiding_principles_annotated_bibliography_2014june23.pdf).
- Charles A. Dana Center. 2014f. *The New Mathways Project Implementation Guide*. In collaboration with the Texas Association of Community Colleges. Austin: The University of Texas at Austin. Website: [www.utdanacenter.org/higher-education/new-mathways-project/new-mathways-project-technical-assistance/new-mathways-project-implementation-guide/](http://www.utdanacenter.org/higher-education/new-mathways-project/new-mathways-project-technical-assistance/new-mathways-project-implementation-guide/).
- Charles A. Dana Center. 2014g. "Statewide Implementation of the New Mathways Project." Website: [www.utdanacenter.org/higher-education/new-mathways-project/the-new-mathways-project-in-texas/statewide-implementation-of-the-new-mathways-project/](http://www.utdanacenter.org/higher-education/new-mathways-project/the-new-mathways-project-in-texas/statewide-implementation-of-the-new-mathways-project/).
- Charles A. Dana Center. 2014h. "Statistical Reasoning: Student Learning Objectives." Website: [www.utdanacenter.org/wpcontent/uploads/NMP\\_Statistical\\_Reasoning\\_Outcomes\\_Version\\_1.0.pdf](http://www.utdanacenter.org/wpcontent/uploads/NMP_Statistical_Reasoning_Outcomes_Version_1.0.pdf).
- Charles A. Dana Center. 2014i. "Texas Higher Education Coordinating Board Approves Change to Texas Success Initiative (TSI) Rules to Aid Implementation and Scale of NMP." Website: [www.utdanacenter.org/higher-education/higher-education-resources/policy-resources/college-readiness/](http://www.utdanacenter.org/higher-education/higher-education-resources/policy-resources/college-readiness/).
- Charles A. Dana Center. 2014j. "Transfer and Applicability FAQ: Fall 2014 Updated Edition." Website: [www.utdanacenter.org/wp-content/uploads/texas\\_transfer\\_and\\_applicability\\_FAQ\\_2014\\_September.pdf](http://www.utdanacenter.org/wp-content/uploads/texas_transfer_and_applicability_FAQ_2014_September.pdf).
- Charles A. Dana Center. 2014k. "Transforming Post-Secondary Education in Mathematics (TPSE Math) Project." Website: [www.utdanacenter.org/transforming-post-secondary-education-in-mathematics-tpse-math-project/](http://www.utdanacenter.org/transforming-post-secondary-education-in-mathematics-tpse-math-project/).
- Charles A. Dana Center. 2015. "Scaling Modern Undergraduate Mathematics." Website: [www.utdanacenter.org/higher-education/higher-education-resources/policy-resources/scaling-modern-undergraduate-mathematics/](http://www.utdanacenter.org/higher-education/higher-education-resources/policy-resources/scaling-modern-undergraduate-mathematics/).
- Coburn, Cynthia E. 2003. "Rethinking Scale: Moving Beyond Numbers to Deep and Lasting Change." *Educational Researcher* 32, 6: 3-12.
- Cohen, David K., and Deborah Loewenberg Ball. 2000. *Instructional Innovation: Reconsidering the Story*. Working paper for the Study of Instructional Improvement. Ann Arbor: University of Michigan.
- Cuban, Larry. 1993. *How Teachers Taught: Constancy and Change in American Classrooms, 1890-1990*. New York: Teachers College Press.
- Cullinane, Jenna. 2013. "Three Big Ideas for Designing Innovations to Work at Scale." *The Stanford Social Innovation Review* (July 9). Website: [www.ssireview.org](http://www.ssireview.org).

- Cullinane, Jenna, Shelby Carvalho, and Jesse Tow. 2014a. "Mathematics for Communications: Recommendations from Professional Organizations and Requirements from Texas Institutions of Higher Education." Website: [www.utdanacenter.org/wp-content/uploads/NMP\\_brief\\_math\\_COMMUNICATIONS.pdf](http://www.utdanacenter.org/wp-content/uploads/NMP_brief_math_COMMUNICATIONS.pdf).
- Cullinane, Jenna, Shelby Carvalho, and Jesse Tow. 2014b. "Mathematics for Nursing: Recommendations from Professional Organizations and Requirements from Texas Institutions of Higher Education." Website: [www.utdanacenter.org/wp-content/uploads/NMP\\_brief\\_math\\_NURSING\\_2014.pdf](http://www.utdanacenter.org/wp-content/uploads/NMP_brief_math_NURSING_2014.pdf).
- Cullinane, Jenna, and Jesse Tow. 2014a. "Mathematics for Criminal Justice: Recommendations from Professional Organizations and Requirements from Texas Institutions of Higher Education." Website: [www.utdanacenter.org/wp-content/uploads/NMP\\_brief\\_math\\_CRIMINALJUSTICE\\_2014.pdf](http://www.utdanacenter.org/wp-content/uploads/NMP_brief_math_CRIMINALJUSTICE_2014.pdf).
- Cullinane, Jenna, and Jesse Tow. 2014b. "Mathematics for Social Work: Recommendations from Professional Organizations and Requirements from Texas Institutions of Higher Education." Website: [www.utdanacenter.org/wp-content/uploads/NMP\\_brief\\_math\\_SOCIALWORK\\_2014.pdf](http://www.utdanacenter.org/wp-content/uploads/NMP_brief_math_SOCIALWORK_2014.pdf).
- Duckworth, Angela Lee, and Patrick D. Quinn. 2009. "Development and Validation of the Short Grit Scale (Grit-S)." *Journal of Personality Assessment* 91, 2: 166-174. doi:10.1080/00223890802634290.
- Dweck, Carol. 2006. *Mindset: The New Psychology of Success*. New York: Random House.
- Elmore, Richard F., Penelope L. Peterson, and Sarah J. McCarthy. 1996. *Restructuring in the Classroom: Teaching, Learning, and School Organization*. San Francisco: Jossey-Bass Inc.
- Fain, Paul. 2012. "How to End Remediation." *Inside Higher Ed* (April 4). Website: [www.insidehighered.com](http://www.insidehighered.com).
- Fain, Paul. 2013. "Remediation If You Want It." *Inside Higher Ed* (June 5). Website: [www.insidehighered.com](http://www.insidehighered.com).
- Fain, Paul. 2014. "Low Expectations, High Stakes." *Inside Higher Ed* (April 7). Website: [www.insidehighered.com](http://www.insidehighered.com).
- Fong, Kelley, and Mary Visher. 2013. *Fast Forward: A Case Study of Two Community College Programs Designed to Accelerate Students Through Developmental Math*. New York: MDRC.
- Ganter, Susan L., and William E. Haver. 2011. "Partner Discipline Recommendations for Introductory College Mathematics and the Implications for College Algebra." Washington, DC: Mathematical Association of America.
- Grubb, W. Norton. 2013. *Basic Skills Education in Community Colleges: Inside and Outside of Classrooms*. New York: Routledge.

- Handel, Michael J. 2010. "What Do People Do At Work? A Profile of U.S. Jobs from the Survey of Workplace Skills, Technology, and Management Practices (STAMP)." Unpublished paper. Boston: Northeastern University.
- Hoyles, Celia, Richard Noss, and Stefano Pozzi. 2001. "Proportional Reasoning in Nursing Practice." *Journal for Research in Mathematics Education* 32, 1: 4-27.
- Jaggars, Shanna S., Nikki Edgecombe, and Georgia W. Stacey. 2014. "What We Know About Accelerated Developmental Education." New York: Community College Research Center, Teachers College, Columbia University.
- Jenkins, Paul Davis. 2011. "Redesigning Community Colleges for Completion: Lessons from Research on High-Performance Organizations." CCRC Working Paper (Assessment of Evidence Series). New York: Community College Research Center, Teachers College, Columbia University.
- Quint, Janet C., and D. Crystal Byndloss. 2003. *Scaling Up First Things First: Findings from the First Implementation Year*. New York: MDRC.
- Quint, Janet C., D. Crystal Byndloss, Herbert Collado, Alissa Gardenhire, Asya Magazinnik, Genevieve Orr, Rashida Welbeck, and Shanna S. Jaggars. 2011. *Scaling Up Is Hard to Do: Progress and Challenges During the First Year of the Achieving the Dream Developmental Education Initiative*. New York: MDRC.
- Quint, Janet C., Shanna S. Jaggars, D. Crystal Byndloss, and Asya Magazinnik. 2013. *Bringing Developmental Education to Scale: Lessons from the Developmental Education Initiative*. New York: MDRC.
- Smith, John Philip. 1999. "Tracking the Mathematics of Automobile Production: Are Schools Failing to Prepare Students for Work?" *American Education Research Journal* 34, 4: 835-878.
- Snell, Myra. 2010. "Role of Faculty Learning in Community Colleges." Presentation at Carnegie Foundation meeting. Video. Website: <http://vimeo.com/2765820>.
- Strother, Scott, James Van Campen, and Alicia Grunow. 2013. *Community College Pathways: 2011-2012 Descriptive Report*. Stanford, CA: The Carnegie Foundation for the Advancement of Teaching. Website: [www.carnegiefoundation.org/](http://www.carnegiefoundation.org/).
- Texas Higher Education Coordinating Board. 2013. "FAQ: TSI-Developmental Education." Website: [www.thecb.state.tx.us/download.cfm?downloadfile=9AEE81A9-C13D-1203-2DFB56A124C9DBBD&typename=dmFile&fieldname=filename](http://www.thecb.state.tx.us/download.cfm?downloadfile=9AEE81A9-C13D-1203-2DFB56A124C9DBBD&typename=dmFile&fieldname=filename).
- Texas Higher Education Coordinating Board. 2014a. "Negotiated Rulemaking Committee on Texas Success Initiative (TSI)." Website: [www.thecb.state.tx.us/index.cfm?objectid=C3E26321-B147-E9CC-21623973A052176D](http://www.thecb.state.tx.us/index.cfm?objectid=C3E26321-B147-E9CC-21623973A052176D).
- Texas Higher Education Coordinating Board. 2014b. "Overview: Texas Success Initiative." March. Website: [www.thecb.state.tx.us](http://www.thecb.state.tx.us).

- Texas Higher Education Coordinating Board. 2015. Texas Higher Education Coordinating Board Developmental Education Accountability Measures Data. Accessed January 30. Website: [www.txhighereddata.org/reports/performance/deved/inst.cfm?inst=778888&report\\_type=2&report\\_yr=2013](http://www.txhighereddata.org/reports/performance/deved/inst.cfm?inst=778888&report_type=2&report_yr=2013).
- Treisman, Uri. 2011. "Rethinking Developmental Math." Presentation at North Carolina Community College System Math Faculty Convening. Video. Website: [www.youtube.com/watch?v=NB5t3CIcSMo](http://www.youtube.com/watch?v=NB5t3CIcSMo).
- Treisman, Uri. 2014. "National Trends in Collegiate Mathematics." Presentation sponsored by TG, the Mathematical Association of America, and the American Mathematical Association of Two-Year Colleges. Round Rock, Texas (January 29). Video. Website: <http://tgslc.adobeconnect.com/p3r3da2j712/>.
- Tyack, David, and Larry Cuban. 1997. *Tinkering toward Utopia: A Century of Public School Reform*. Cambridge, MA: Harvard University Press.
- Visher, Mary G., Michael J. Weiss, Evan Weissman, Timothy Rudd, and Heather D. Wathington. 2012. *The Effects of Learning Communities for Students in Developmental Education: A Synthesis of Findings from Six Community Colleges*. New York: National Center for Postsecondary Research.
- White House. 2014. *Fact Sheet: Improving College Opportunity*. Washington, DC: Office of the Press Secretary, The White House. Website: [www.whitehouse.gov](http://www.whitehouse.gov).
- Yeager, David Scott, and Carol S. Dweck. 2012. "Mindsets That Promote Resilience: When Students Believe That Personal Characteristics Can Be Developed." *Educational Psychologist* 47, 4: 302-314.
- Zachry Rutschow, Elizabeth, and Emily Schneider. 2011. *Unlocking the Gate: What We Know About Improving Developmental Education*. New York: MDRC.
- Zachry Rutschow, Elizabeth, Lashawn Richburg-Hayes, Thomas Brock, Genevieve Orr, Oscar Cerna, Dan Cullinan, Monica Reid Kerrigan, Davis Jenkins, Susan Gooden, and Kasey Martin. 2011. *Turning the Tide: Five Years of Achieving the Dream in Community Colleges*. New York: MDRC.
- Zachry Rutschow, Elizabeth, and Shane Crary-Ross. 2014. *Beyond the GED: Promising Models for Moving High School Dropouts to College*. New York: MDRC.

## About MDRC

MDRC is a nonprofit, nonpartisan social and education policy research organization dedicated to learning what works to improve the well-being of low-income people. Through its research and the active communication of its findings, MDRC seeks to enhance the effectiveness of social and education policies and programs.

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.

Over the years, MDRC has brought its unique approach to an ever-growing range of policy areas and target populations. Once known primarily for evaluations of state welfare-to-work programs, today MDRC is also studying public school reforms, employment programs for ex-offenders and people with disabilities, and programs to help low-income students succeed in college. MDRC's projects are organized into five areas:

- 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.