Carnegie Foundation
for the Advancement of Teaching

JANUARY
2017

IMPROVEMENT VIGNETTE

How a Networked Improvement Community Improved Success Rates for Struggling College Math Students

IN ORDER FOR OUR NATION to have a workforce that's ready for the challenges of tomorrow, our community colleges must be better equipped to build essential math skills in all students. Despite years and billions of dollars of programs, however, low-income, black, and Hispanic students still have less access to quality and higher-level high school math classes where they would learn the skills required to succeed in college math. The problem is so critical that the President's Council of Advisors on Science and Technology recommended that the National Science Foundation and U.S. Departments of Labor and Education commit $20 million a year to fund initiatives aimed at improving math education in college. "Reducing or eliminating the mathematics-preparation gap is one of the most urgent challenges—and promising opportunities—in preparing the workforce of the 21st century," the commission wrote.[1]

Right now, the system for improving math skills typically consists of developmental (or remedial) math sequences. Hundreds of thousands of community college students are enrolled in developmental math each year. While the original intention of these

courses was to create more access to higher education for students admitted to community college under open enrollment programs, they have become a gatekeeper rather than a gateway to opportunity.

When Anthony S. Bryk became president of the Carnegie Foundation for the Advancement of Teaching in 2008, there was universal agreement that developmental education was broken. Despite numerous efforts, high failure rates stubbornly refused to budge. Alternatives being tried at the time either didn't work or couldn't be successfully scaled beyond their local campus. Just 5 percent of developmental students who follow the traditional path achieve college math credit within one year, and 80 percent—about 400,000 a year—don't succeed even after three years. That's more than the entire K-12 enrollment in at least 18 states.[2]

"The bumper sticker for this problem," said Bryk, is that "developmental math is where aspirations go to die." Students can succeed in meeting every other requirement for moving forward with their education, but this roadblock remains.

That roadblock nearly ended Khealah Hoskins' college aspirations. She failed so many developmental math classes at Napa Valley College that she had to transfer to another California community college in order to remain in school. When she switched to Diablo Valley College, Hoskins' counselor suggested she enroll in Statway®, a rigorous alternative to traditional offerings.

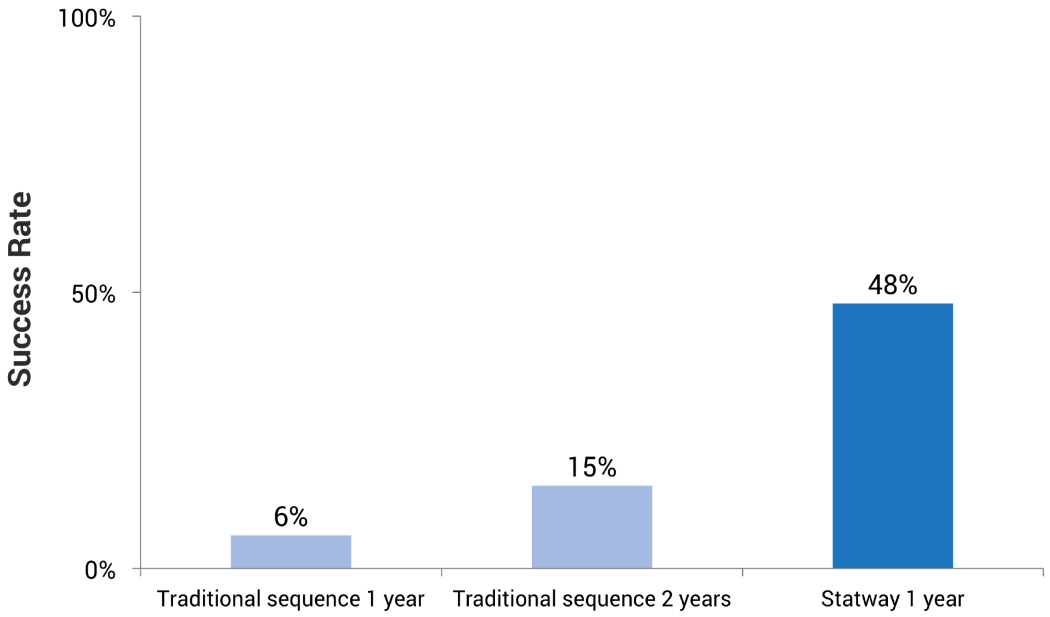
Triple the Success Rate in Half the Time

Statway and its sister initiative Quantway® compose the Pathways program. Both were designed and refined by the Carnegie Foundation and a team of community college partners in response to the hundreds of thousands of community college students like Hoskins for whom conventional developmental math has become a barrier to a college degree.

Statway student Khealah Hoskins speaking at the 2016 Pathways National Forum

Students who don't pass a college-level math class can forget about earning associate degrees, transferring to four-year colleges, or enrolling in many specialized certification programs. For most students this forecloses access to higher-paying 21st century careers and weakens the nation's future economic base. At a more personal level, it diminishes their sense of self and undermines their hopefulness for a better life. And, because community colleges educate a disproportionate number of disadvantaged students[3], many of those thwarted by developmental math have already been shortchanged by inadequate education systems.

STATWAY HAS TRIPLED THE SUCCESS RATE IN HALF THE TIME



Bryk regarded the situation as "one of the great social justice issues of our time," and was determined to have Carnegie figure out how to open that gate to opportunity.

Hoskins describes her losing battle with math as feeling like a "fresh wound." She hadn't done well in math since middle school. Even then, she jokes, her teacher gave her "charity points" for trying hard. Yet, just weeks into Statway, Hoskins scored 97 percent on her first test.

She's not an outlier. Pathways students are significantly more successful than non-Pathways students in virtually every college where these initiatives have been implemented. Statway and Quantway combined have served more than 20,000 students since the 2011-2012 academic year when they launched with 1,551 students at 29 colleges. This year, 6,220 students are enrolled in Pathways courses at 36 colleges in 14 states.

It Takes a Network to Create Opportunity

Pathways emerged from an innovative strategy adopted by the Carnegie Foundation called a Networked Improvement Community (NIC). Carnegie created a team, drawing together select academic researchers and community college math professors with diverse, yet complementary, expertise.[4] The team worked in a new way, guided by the principles of improvement science. Through this synergistic process, the network identified a specific problem or

set of problems to be solved, and then designed an integrated set of changes that they repeatedly tested and refined. To achieve quality outcomes reliably at scale, NIC members knew that they had to make all of this work for different subgroups of students, under the varied constraints and circumstances of different classrooms and colleges in which student instruction occurs.

A goal of improvement science is to know not just what works, but for whom, and under what set of circumstances.

They initially began working in small joint researcher and practitioner sub-groups on the separate pieces that would quickly be combined to form each Pathway solution. At each step, they examined data to see if the changes were actually improvements.

It would be easy to lay the blame for developmental math's shortcomings on a single source, such as poor curriculum materials, ineffective teaching, or disengaged students. However, Bryk and his colleagues recognized that multiple factors interacted to create the unsatisfactory outcomes observed, and knew that they needed to understand more deeply how the current system operated in order to fix it. "The education systems that we've built and the problems embedded within them are now so complex that very few can solve them on their own," said Bryk. "We need coordinated collective action involving a range of expertise."[5]

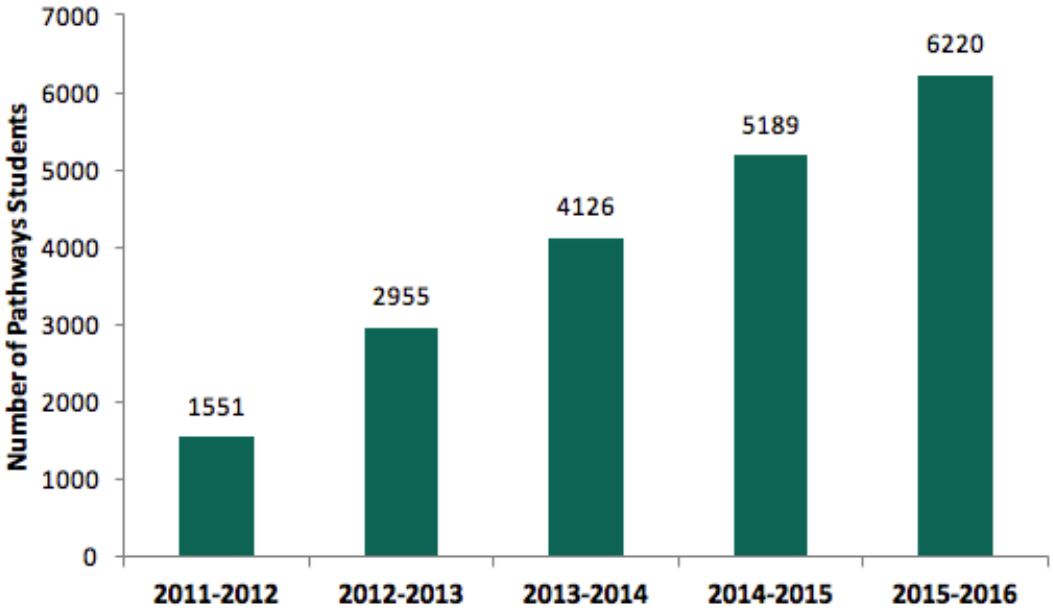
Keeping the Focus on the Problem at Hand

The NIC set a goal of raising the one-year success rate—the percentage of students progressing through traditional developmental math and then going on to pass the required credit-bearing math course—from 5 percent to 50 percent. An exhaustive review of existing developmental math programs didn't find any that could serve as a model.

Applying the improvement science principle of being user-centered, the NIC turned to students for clues and found it eye-opening. Drawing on a protocol from design thinking called journey maps, NIC members listened as the students described their experiences and how these stories shaped their beliefs about what was and was not possible in their lives. They identified both external and self-imposed barriers that were leading students to disengage from traditional developmental math.

- It could take students two or more years to get through because of complexities in the registration processes.
- Required courses might not be offered at a time that fit with their work schedules and family responsibilities.
- The material they were being asked to learn seemed very abstract and irrelevant to their lives. Students asked, "Why do I have to factor trinomials or do algebra with complex numbers?"
- Teaching was very traditional "chalk and talk" and students often felt uncomfortable asking questions in class.

PATHWAYS ENROLLMENT OVER FIVE YEARS



- They had come to think about themselves as "not good at math," which amplified lingering doubts about whether they really belonged in college at all.
- For many, no one in their families had ever achieved a college degree.

"It turns out the single strongest predictor of whether a student will persist to completion of the first year is how students responded to this one question," explained Bryk. "How often is it that you wonder, 'Maybe I don't belong here?'"

This new perspective gave the NIC the direction it needed. Instead of seeking just a pedagogical or curricular fix, they addressed the specific barriers and challenges faced by the students. That led them to create the Pathways program. Rather than placing students into a traditional remedial class, which could be demoralizing as well as ineffective, they would give students the option of enrolling in a college-level math course, but ensuring they had the intensive support necessary to master the math concepts and skills required to earn college math credit.

Statway would be based in college-level statistics, and Quantway anchored in a college math curriculum for liberal arts majors called Quantitative Reasoning. Drawing on research evidence about more effective mathematics teaching, lessons would be problem-based and instruction designed for more active student participation. Students would learn math by encountering its everyday uses such as figuring out which cell phone plan is the best value, how to ana-

lyze the validity of poll results, and how to understand scatterplots by analyzing and comparing the nutritional information on cereal boxes.

Quantway student Kim Sherwood said she learned how to better manage her finances following a lesson in which she learned how to use spreadsheets to analyze credit card debt. Understanding the details, said Sherwood, "can make a huge difference in what amount you pay on your credit card bills."

Professor Michelle Brock teaches Statway at American River College

A Sense of Belonging

Visit any Statway and Quantway classroom and students will be clustered into small groups to work out math problems together and, in the process, find social and psychological support. Some faculty members built on this design to reinforce social connections in their classrooms and strenghten the sense of belonging among their students. At California's American River College, for example, Statway Professor Michelle Brock starts every class by asking students to call or text missing classmates to make sure they're okay and to let them know their presence is missed. It's a way of reminding them "you're an important part of this class," explained Brock.

"The people in this class are more like a family than a classroom," said Statway student Elizabeth Belmont. "Not only will you leave with a higher education; you'll leave with friends."

Accompanying this was a deliberate effort to counter the fixed mindsets that many students had developed that "I am just not good at math." To address this problem, the NIC developed and tested growth mindset strategies based on the pioneering work of psychologist Carol Dweck. Growth mindset is a belief that intelligence and ability aren't fixed, that with practice and persistence, people have the capacity to build new brain connections.

Continuous Improvement Cycles

Pathways enrollment has been growing at a steady pace with a 300 percent increase in Statway in just over five years. Even with that surge, half of all Statway students received college math credit after one year. Similarly, 60 percent of Quantway students successfully completed the developmental class in one semester.

Yet, not everything worked in every classroom as the initiatives were being implemented and expanded. The organizing hub for the NIC at Carnegie took on the task of identifying emerging problems and forming improvement teams to work on them. As

the Pathways spread to more classrooms and colleges, NIC leaders expected variability in outcomes to emerge. The NIC needed to know what would work, for whom, and under what set of circumstances.

Using improvement science instead of intuition, educators get better at problem solving.

If the program didn't meet expectations in some places, they had to understand why. Conversely, they needed to know what was behind the extraordinary success in other places. For either outcome, they asked themselves, "what valuable lesson might be learned that could possibly help everyone get even better?" They continue to measure their results today in an effort to improve future results even more.

With five years of growth and measurement behind it, Pathways has shown that by working within a network and by using the basic tools and methods of improvement science, rather than relying solely on intuition and hunches, researchers and practitioners can improve the way they solve problems in education and give renewed opportunities to students like Khealah Hoskins.

"The confidence [I have in math] is the biggest difference," said Hoskins. "To actually have gotten those things right, that's when I realized I am getting it. This isn't a fluke."

SOURCES

1. Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics, Feb. 2012.
2. National Center for Education Statistics, Digest of Education Statistics. http://nces.ed.gov/programs/digest/d15/tables/dt15_203.20.asp
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5. https://www.carnegiefoundation.org/get-involved/events/summit-improvement-education/

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Carnegie Foundation for the Advancement of Teaching is committed to developing networks of ideas, individuals, and institutions to advance teaching and learning. We join together scholars, practitioners, and designers in new ways to solve problems of educational practice. Toward this end, we work to integrate the discipline of improvement science into education with the goal of building the field's capacity to improve.

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www.carnegiefoundation.org/math

Suggested citation:

Carnegie Foundation for the Advancement of Teaching. (2017). *How a Networked Improvement Community Improved Success Rates for Struggling College Math Students*. Stanford, CA: Author.