



Carnegie Foundation
for the Advancement of Teaching



CARNEGIE MATH
PATHWAYS
WestEd 

2016-2017 Impact Report: Six Years of Results from the Carnegie Math Pathways™

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CARNEGIE MATH PATHWAYS
TECHNICAL REPORT

Abstract

Traditional developmental mathematics sequences are a major impediment for community college students who need to acquire college-level mathematics credit in order to attain their long-term academic goals. Each year, approximately 500,000 students fail to complete their developmental mathematics coursework,¹ jeopardizing their ability to earn an associate degree or technical certification, and/or transfer to a four-year institution for further education. In response to this national crisis, the Carnegie Foundation for the Advancement of Teaching founded the Carnegie Math Pathways. The Pathways include Statway® and Quantway®, two alternative courses that accelerate students' progress to and through college-level mathematics. Since launching in 2011, the Pathways have served over 27,000 students and consistently demonstrated significantly higher success rates than the traditional course sequence. In 2016-2017, Pathways success rates increased further, even as the program served nearly five times as many students as in its first year.

This report provides descriptive statistics for 2016-2017 student outcomes as well as insights into potential areas for improvement, based on data from the Pathways' sixth year of implementation.

The Problem

Each year, more than 1.7 million first-time students² enter the community college system. Based primarily upon performance on a placement test, approximately 60% of these students are placed into one, if not more, developmental mathematics course(s). Fully 80% of them do not complete any college-level mathematics courses within as many as three years (Bailey, Jeong, & Cho, 2010). Many students instead spend years languishing in developmental mathematics sequences by repeating previously failed courses. Without a college-level math credit, they may drop out of college altogether without earning a degree or certificate. Developmental mathematics is a gatekeeper barring students from pursuing their academic and professional aspirations.

The Pathways Solution

In light of this national crisis, the Carnegie Foundation for the Advancement of Teaching established a network of college faculty, administrators, researchers, and program designers that co-created a transformative approach to developmental mathematics education: the Carnegie Math Pathways (formerly known as the Community College Pathways or CCP). The Pathways Networked Improvement Community (NIC) unites people in applying their individual expertise to achieve a common aim through disciplined inquiry and iterative testing of changes addressing a shared working theory of improvement (Bryk, Gomez, Grunow, & LeMahieu, 2015). Today, the Carnegie Math Pathways program is operated by WestEd, a national nonprofit education research and services organization.

¹ Bailey, Jeong, and Cho (2010) claim that approximately 60% of first-time community college students are placed into developmental math courses. Of those students, up to 80% do not complete their credit-bearing math course within three years. According to data retrieved on March 13, 2017, from the National Center for Education Statistics-IPEDS Data Center, the average number of first-time community college students from 2011 to 2015 was approximately 1,100,000 annually. 60% of that figure is 660,000, and 80% of this new amount is 528,000. Thus, approximately half a million students each year do not obtain college math credit.

² See Snyder and Dillow (2011), Table 241.

Currently, the Pathways offer two alternative developmental mathematics programs, Statway® and Quantway® (see Figure 1). Statway is a year-long, college-level statistics sequence designed with supports for developmental math students. It integrates developmental and college-level content so students who complete the entire pathway fulfill both their remedial and college-level mathematics requirements, earning a college-level math credit. Quantway is a two-term quantitative reasoning pathway comprised of a developmental math course, Quantway 1, and a college-level course, Quantway 2. In both of its courses, Quantway embraces a substantive focus on quantitative reasoning. Statway and Quantway enable developmental math students to earn college-level mathematics credit in a single year, instead of the two or more years required with the traditional algebra-based sequence of courses. Further, the Pathways engage students in the statistical and quantitative reasoning concepts increasingly seen as more relevant to many students' educational and career goals than those in the traditional algebraic sequence.

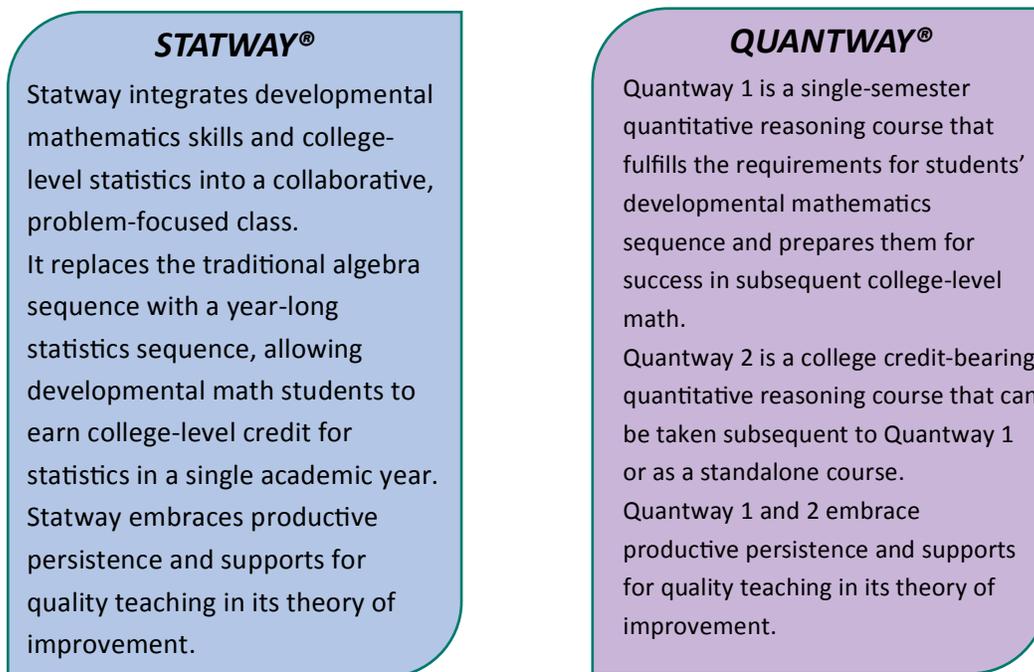


Figure 1. Statway® and Quantway® Descriptions

Importantly, the Pathways initiative operates as a networked improvement community (NIC) using an improvement science framework. Improvement science uses evidence from rapid tests of change ideas to guide the development, revision, and iterative calibration of tools, processes, roles, and relationships to accelerate how a field learns to improve and address problems of practice. The innovative approach of the Pathways is represented by a driver diagram (see Figure 2), which serves as a shared working theory guiding the improvement work of its network members. The left-hand side of the driver diagram outlines the aim of the Pathways: to change developmental math from a gatekeeper to a gateway for students. The right-hand side of the driver diagram lists the seven primary

drivers, which are components of the Pathways that are essential to the initiative’s ability to reach its aim.³

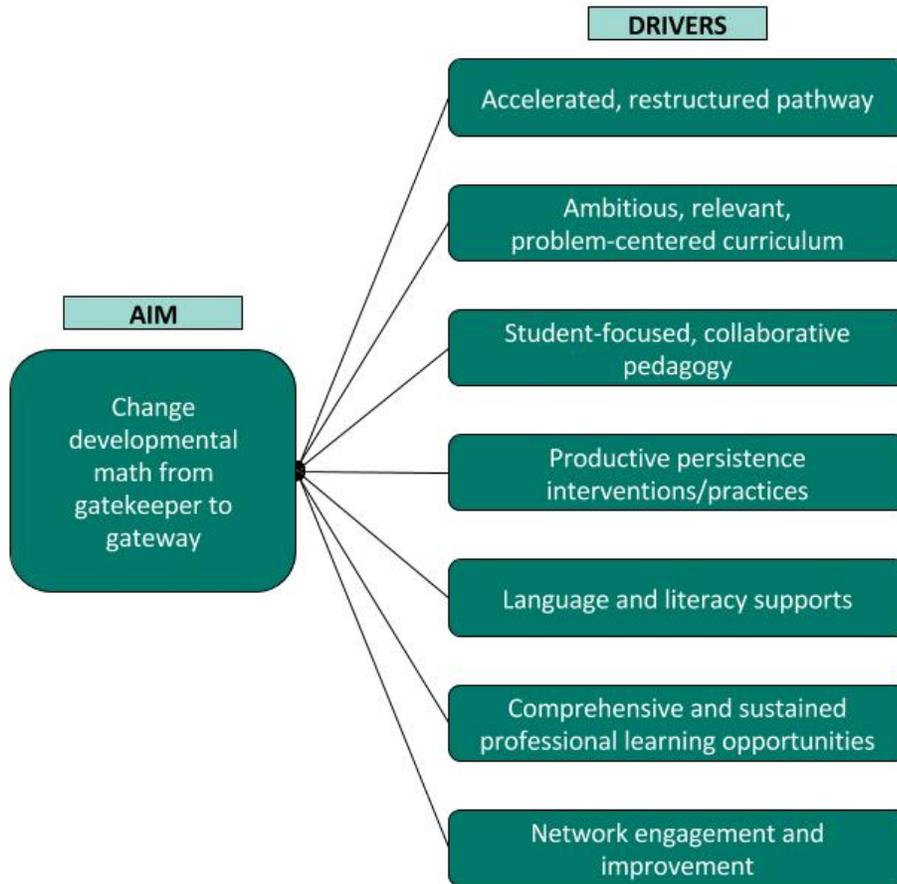


Figure 2. Pathways Driver Diagram

Pathways Enrollment

Statway and Quantway have achieved steady enrollment growth since launching in 2011-2012, and continue to spread to new campuses, scale at extant institutions, and serve more students with each passing year. The average increase in enrollment per year is 64%. In 2016-2017, total enrollment was 7,522 (see Table 1)—nearly five times that of the first year of enrollment—with 415 sections taught by 224 faculty members across 48 institutions (see Appendix, Table A1).

Strikingly, Pathways success rates have remained consistently high in spite of the initiative’s ongoing expansion. Over the course of six years, the program has maintained high success rates while serving increasingly larger student populations (Hoang, Huang, Sulcer, & Yesilyurt, 2017; Huang, Hoang, Yesilyurt, & Thorn, 2016; Sowers & Yamada, 2015; Strother, Van Campen, & Grunow, 2013; Van Campen, Sowers, & Strother, 2013).

³ For more information on the Pathways system, please visit <http://carnegiemathpathways.org>.

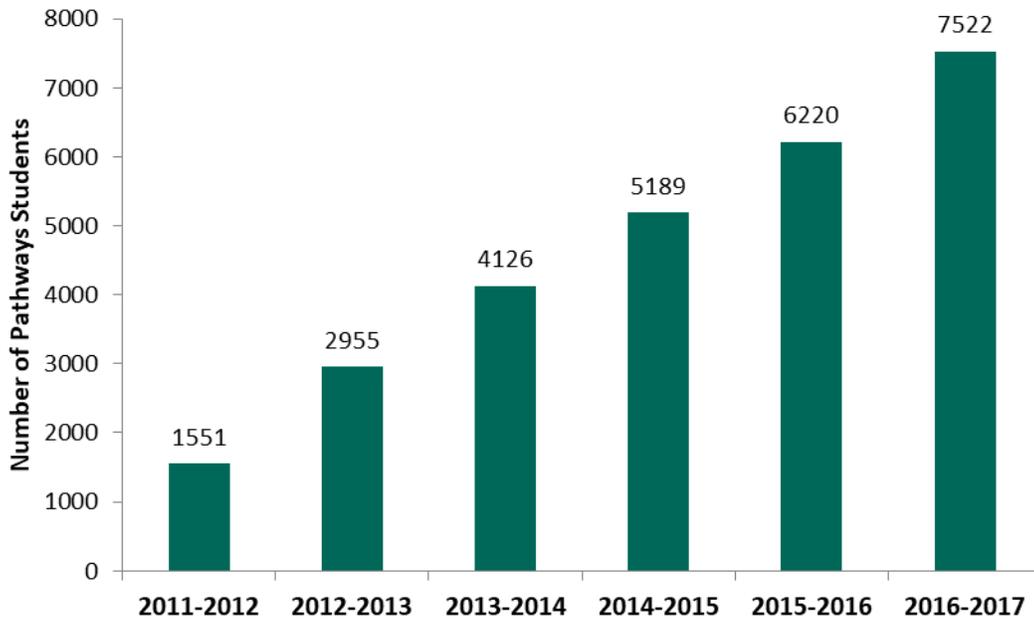


Figure 3. Pathways Enrollment Over Six Years

Table 1. Pathways Enrollment, 2011-2017⁴

| | | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |
|--------------|---------------------|--------------|--------------|--------------|-----------------------|--------------|--------------|
| Statway | Students | 1,133 | 1,553 | 2,283 | 2,862 | 3,254 | 3,826 |
| | Institutions | 21 | 22 | 22 | 26 | 21 | 24 |
| Quantway | Students | 418 | 1,402 | 1,843 | 2,327 | 2,966 | 3,696 |
| | Institutions | 8 | 8 | 11 | 13 | 16 | 25 |
| Total | Students | 1,551 | 2,955 | 4,126 | 5,189 | 6,220 | 7,522 |
| | Institutions | 29 | 30 | 33 | 38⁵ | 36 | 48 |

⁴ Data reported in this table (and subsequent tables and figures) may vary slightly from statistics reported in previous impact reports. This difference exists because data have been updated to reflect new and more accurate information from participating colleges. In addition, data used to compute success rates for 2016-2017 and after are reported directly by faculty, whereas data for the previous years are from institutional research data.

⁵ Starting in Year 4, the total number of unique Pathways institutions does not equal the sum of the total number of unique Statway institutions plus the total number of unique Quantway institutions, because some institutions offered both Statway and Quantway.

Statway Student Performance

Statway’s success rate is defined as the percentage of students who started the course in the fall academic term and completed the full, year-long sequence with a grade of C or higher (the outcome required on most campuses for college credit to be awarded).⁶ Overall, there were a total of 2,891⁷ students enrolled in the Fall 2016 cohort, and 1,780 (62%) successfully completed Statway. Table 2a shows Statway student success across all participating institutions—community colleges and four-year universities—over six years of implementation.

Table 2a. Statway Student Success at Community Colleges and Four-Year Institutions

| | Institutions | Size of Analytic Sample | Students Successfully Completing the Full Pathway | Success Rate |
|------------------|--------------|-------------------------|---|--------------|
| Fall 11 Cohort | 18 | 1,120 | 557 | 50% |
| Fall 12 Cohort | 22 | 1,057 | 598 | 57% |
| Fall 13 Cohort | 22 | 1,435 | 737 | 51% |
| Fall 14 Cohort | 18 | 1,485 | 720 | 48% |
| Fall 15 Cohort | 21 | 2,531 | 1,263 | 50% |
| Fall 16 Cohort | 22 | 2,891 | 1,780 | 62% |
| All Fall Cohorts | 39 | 10,488 | 5,639 | 54% |

The Fall 2016 cohort included 2,816 community college students, of whom 1,725 (61%) completed the full sequence with a grade of C or higher and earned college credit (see Table 2b). On average across all six years, approximately 52% of community college students successfully completed Statway.

Table 2b. Statway Student Success at Community Colleges

| | Institutions | Size of Analytic Sample | Students Successfully Completing the Full Pathway | Success Rate |
|-----------------------------|--------------|-------------------------|---|--------------|
| Fall 11 Cohort | 18 | 968 | 468 | 48% |
| Fall 12 Cohort | 18 | 853 | 445 | 52% |
| Fall 13 Cohort | 19 | 1,294 | 620 | 48% |
| Fall 14 Cohort | 16 | 1,391 | 652 | 47% |
| Fall 15 Cohort ⁸ | 20 | 2,467 | 1,212 | 49% |
| Fall 16 Cohort | 21 | 2,816 | 1,725 | 61% |
| All Fall Cohorts | 34 | 9,789 | 5,122 | 52% |

⁶ If a grading system is used that employs +/-, success in a course is defined as achieving a C- or higher. For the purpose of calculating the success rates, the denominator of the ratio includes those who received W (Withdraw) or I (Incomplete) grades, thus generating a more conservative estimate of success.

⁷ The analytic sample is based on students who begin the Statway sequence in the fall academic term. This allows us to compare one academic year to another based upon comparable conditions. Accelerated (one-term) Statway students were included in the analytic sample, regardless of their starting term. Total enrollment figures include students starting in any academic term within a given year. The sample was frozen on September 22, 2017. Thus, outcomes from any courses concluded afterward were not part of this analysis.

⁸ One college offered three-term Statway that began in winter 2016; thus, this academic year includes success numbers in summer 2016 for that particular college.

Though it was intended to serve community college students, Statway has been employed successfully at a number of four-year universities. In the last six years, Statway has been offered at five California State University (CSU) campuses, where success rates have been higher than the NIC average. In 2016-2017, Statway was taught at one CSU campus where 55 of 75 students completed the full sequence, resulting in a 73% success rate (see Table 2c). Because students at community colleges tend to differ from those at traditional colleges in some important ways,⁹ these results suggest that Statway can be beneficial in a variety of contexts.

Table 2c. Statway Student Success at California State Universities

| | Institutions | Size of Analytic Sample | Students Successfully Completing the Full Pathway | Success Rate |
|------------------|--------------|-------------------------|---|--------------|
| Fall 11 Cohort | 2 | 152 | 89 | 59% |
| Fall 12 Cohort | 4 | 204 | 153 | 75% |
| Fall 13 Cohort | 3 | 141 | 117 | 83% |
| Fall 14 Cohort | 2 | 94 | 68 | 72% |
| Fall 15 Cohort | 1 | 64 | 51 | 80% |
| Fall 16 Cohort | 1 | 75 | 55 | 73% |
| All Fall Cohorts | 5 | 730 | 533 | 73% |

Across both community colleges and four-year institutions, Statway results are a dramatic improvement over traditional developmental mathematics outcomes. Only 6% of students placed into developmental mathematics earn college-level mathematics credit in one year through the traditional sequence.¹⁰ Only 15% of students placed into developmental mathematics successfully earn college mathematics credit in two years through the traditional sequence (see Figure 4). In contrast, across all six years of implementation, Statway students are achieving a 54% success rate—more than triple the success in half the time.

⁹ For example, CSU campuses have higher admission requirements than community colleges, which must admit all students. CSU students are also required to complete all developmental requirements in the first year.

¹⁰ To compute this baseline success rate, we worked with institutional researchers from 18 Statway colleges in 2011-2012 to collect data on developmental mathematics course-taking prior to Statway implementation. Analyses revealed that only 5.9% of non-Statway developmental math students enrolled at these colleges in 2008 received credit for college-level mathematics in one year. Additionally, only 15.1% had achieved this goal after two years, 20.4% after three years, and 23.5% after four years.

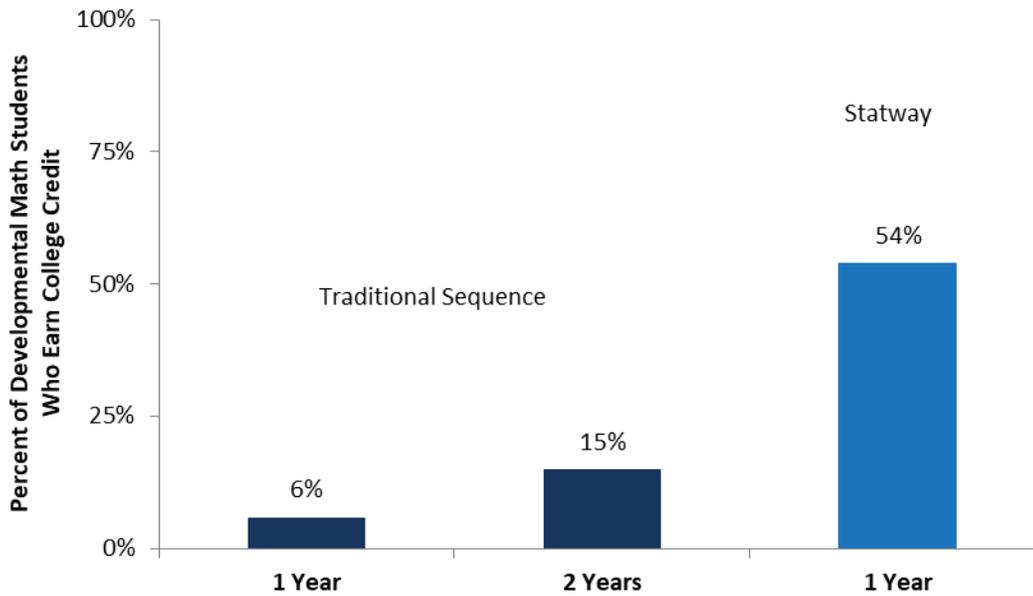


Figure 4. Traditional Programs Versus Statway: Student Success (All Fall Cohorts)

Quantway Student Performance

For Quantway 1, student success is defined as the percent of unique students who enrolled in either the fall or spring terms and completed the course with a C or higher, or a pass in a pass/fail grading system¹¹—thereby fulfilling their developmental math requirements. In 2016-2017, the course achieved the highest success rate in its six years of implementation: 2,310 students (72%) out of 3,227 enrolled successfully completed Quantway 1 (see Table 3a). Among those who successfully completed Quantway 1, 2,463 took the course in community college (with a success rate of 68%) and 764 enrolled in the course at four-year institutions (with a success rate of 84%) (see Table 3b).

Table 3a. Student Success in Completing Developmental Math with Quantway 1 at Community Colleges and Four-Year Institutions

| | Institutions | Size of Analytic Sample | Students Successfully Completing Quantway 1 | Success Rate |
|-----------|--------------|-------------------------|---|--------------|
| 2011-2012 | 8 | 418 | 234 | 56% |
| 2012-2013 | 8 | 1,402 | 732 | 52% |
| 2013-2014 | 11 | 1,805 | 1,062 | 59% |
| 2014-2015 | 11 | 1,936 | 1,107 | 57% |
| 2015-2016 | 16 | 2,680 | 1,724 | 64% |
| 2016-2017 | 23 | 3,227 | 2,310 | 72% |
| Total | 27 | 11,468 | 7,169 | 63% |

Student success in Quantway 1 far exceeds that of students in traditional developmental math sequences. Only 21% of a baseline group of developmental math students passed a traditional

¹¹ If a grading system is used that employs +/-, success in a course is defined as achieving a C- or higher. For the purpose of calculating the success rates, the denominator of the ratio includes those who received W (withdraw) or I (incomplete) grades, thus generating a more conservative estimate of success.

developmental math course within one academic term¹² (see Figure 5). Quantway 1 students, on the other hand, with a 63% weighted average success rate across six years, achieve triple the success of the typical approach in a single semester.

Table 3b. Student Success in Completing Developmental Math with Quantway 1 at Community Colleges versus Four-Year Institutions¹³

| | | Institutions | Size of Analytic Sample | Students Successfully Completing Quantway 1 | Success Rate |
|-----------|------------------------|--------------|-------------------------|---|--------------|
| 2015-2016 | Community Colleges | 13 | 1,813 | 1,079 | 60% |
| | Four-year Institutions | 3 | 867 | 645 | 74% |
| 2016-2017 | Community Colleges | 19 | 2,463 | 1,669 | 68% |
| | Four-year Institutions | 4 | 764 | 641 | 84% |

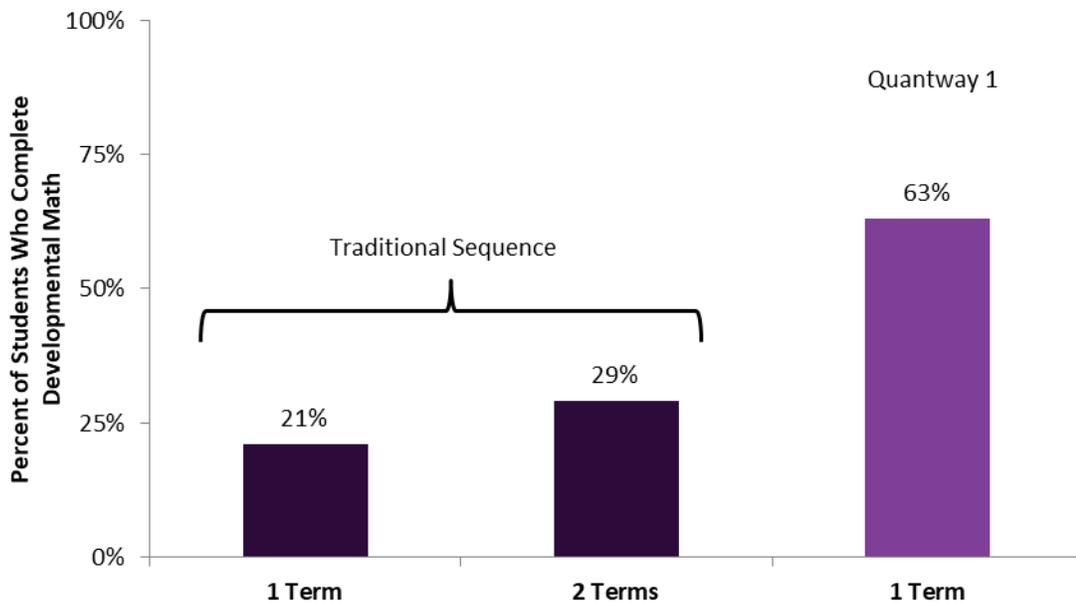


Figure 5. Student Success in Traditional Programs versus Quantway 1

Quantway 2, the college-level companion course to Quantway 1, also yielded promising results in its fifth year of implementation. Of the 814 students enrolled in Quantway 2 in 2016-2017, 624 (77%)

¹² To compute this baseline success rate under the traditional approach, we worked with institutional researchers from six of the first Quantway colleges. Analyses revealed that only 20.6% of students were able to successfully complete their developmental math sequence within a full year. Additionally, 28.5% achieved this goal after two years, 31.6% after three years, and 33.3% after four years.

¹³ Table 3b only includes figures across two years, because 2015-2016 was the first year during which four-year institutions started implementing Quantway 1.

successfully completed the course with a grade of C or better and earned college credit¹⁴ (see Table 4a). This, combined with the prior years of Quantway 2 implementation, results in an overall success rate of 71%.

Table 4a. Student Success in Completing Transfer-level Math with Quantway 2 at Community Colleges and Four-Year Institutions

| | Institutions | Size of Analytic Sample | Students Successfully Completing Quantway 2 | Success Rate |
|-----------|--------------|-------------------------|---|--------------|
| 2012-2013 | 3 | 44 | 30 | 68% |
| 2013-2014 | 5 | 217 | 145 | 67% |
| 2014-2015 | 3 | 168 | 96 | 57% |
| 2015-2016 | 5 | 286 | 193 | 67% |
| 2016-2017 | 7 | 814 | 624 | 77% |
| Total | 10 | 1,529 | 1,088 | 71% |

The success rate at community colleges (72%) is impressive albeit lower than the four-year institution success rate of 81% (see Table 4b). However, the latter success rate may be influenced by institutional effects due to the small number of institutions in the analytic sample. The community college and four-year institution outcomes, taken together, suggest that Quantway 2 is an effective college-level mathematics option and that, similar to Statway, Quantway 2 is applicable to multiple contexts. Quantway 2 can be offered as a stand-alone college-level Quantitative Reasoning course or as part of a coherent Quantway pathway that combines Quantway 1 and 2.

Table 4b. Student Success in Completing Transfer-level Math with Quantway 2 at Community Colleges versus Four-Year Institutions¹⁵

| | | Institutions | Analytic Sample | Students Successfully Completing Quantway 2 | Success Rate |
|-----------|------------------------|--------------|-----------------|---|--------------|
| 2015-2016 | Community Colleges | 4 | 254 | 172 | 68% |
| | Four-Year Institutions | 1 | 32 | 21 | 66% |
| 2016-2017 | Community Colleges | 5 | 406 | 292 | 72% |
| | Four-Year Institutions | 2 | 408 | 332 | 81% |

¹⁴ If a +/- grading system is used, success in a course is defined as achieving a C- or higher. For the purpose of calculating the success rates, the denominator of the ratio includes those who received W (Withdraw) or I (Incomplete) grades, thus generating a more conservative estimate of success.

¹⁵ Table 4b only includes figures across two years, because 2015-2016 was the first year during which four-year institutions started implementing Quantway 2.

Examples of Success in the NIC

A number of institutions have implemented an accelerated version of Statway, one that compresses the entire pathway into a single term. This adaptation, referred to as “accelerated Statway,” removes the transition and potential exit point between Statway 1 and Statway 2 in the standard Statway offering.¹⁶ Although accelerated Statway was offered at only six colleges in 2016-2017, it accounts for over half of the analytic sample in Table 2a. Its outcomes were substantially higher than those of traditional two-term Statway, which in turn raised the overall Statway success rate. Among the 1,456 students who took accelerated

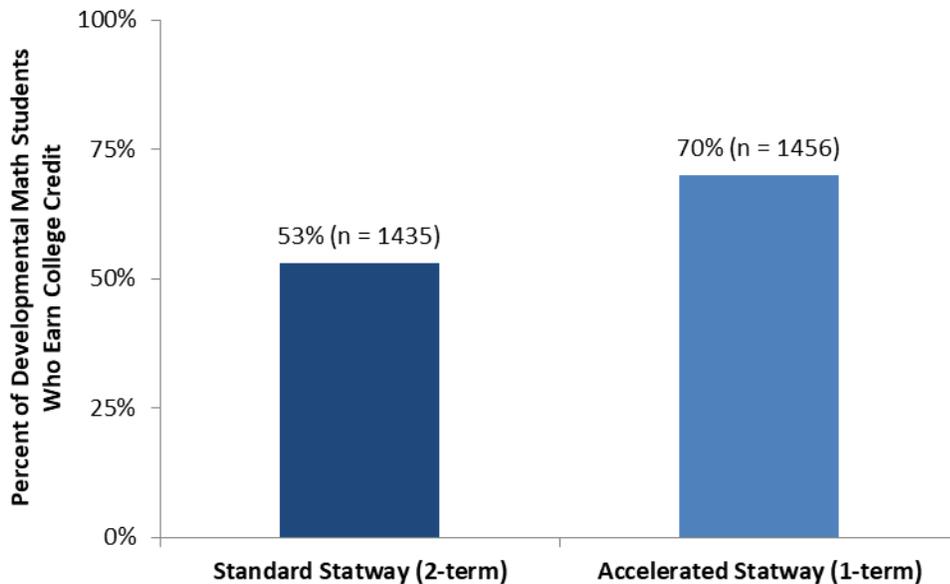


Figure 6. Statway Success by Mode of Implementation in 2016-2017

Statway, 1,014 (70%) successfully completed the program. In contrast, 766 (53%) of the 1,435 students who enrolled in traditional Statway successfully completed the sequence (see Figure 6). With accelerated Statway generating continued interest and success, Pathways team members have interviewed faculty from institutions offering the adaptation to illuminate reasons for adoption, as well as perceived benefits and challenges to implementation (Huang, Norman, & Yamada, 2018). As the Pathways program continues to expand to new colleges, it is critical to investigate which types of adaptations are effective in different institutional contexts.

Additionally, previous impact reports discussed a Statway college that deviated from core design features, such as a) keeping cohorts of students together between the first and second parts of the sequence and b) supporting professional development for Statway faculty. As a result, this institution’s success rates were well below that of the rest of the network as a whole. Because this institution enrolled a large number of students in Statway, it substantially lowered the overall network average success rate (Hoang et. al, 2017; Huang et. al, 2016). In 2016-2017, however, this institution’s success rate increased by over 10%. This institution also experienced a decrease in its withdrawal rate during the first term of Statway: the percentage of students who withdrew from Statway 1 was nearly 16% in

¹⁶ See subsequent section, “Improvement Priorities for Pathways Success,” in which a Pareto analysis identifies students who succeed in Statway 1 but do not enroll in Statway 2 as a major reason for failure to complete the Statway sequence.

2015-2016, but decreased to approximately 7% in 2016-2017. Between 2015-2016 and 2016-2017, this college made substantial adjustments to a few of its practices. First, it changed student eligibility for the course, limiting its Statway student population to non-STEM students for the 2016-2017 academic year. Further, several instructors from this particular college took an optional Pathways Online Preparation (POP) course, which comprises seven modules lasting up to eight hours, during or immediately prior to the 2016-2017 academic year. There is not a clear relationship between these changes and student outcomes. However, the factors contributing to this institution's increased success rates merit further investigation. The Pathways team plans to leverage improvement science methods to learn from this success story, and identify key tools and processes from this college that may be helpful to share with the rest of the network.

Improvement Priorities for Pathways Success

Now, in the sixth year of Pathways implementation, the essential question is how the Pathways may be improved to further increase student success. The NIC is using improvement research tools to explore the ways in which students fail to succeed in order to identify potential new drivers and better target interventions. Of the two Pathways, Statway is more complex, in large part because it maintains a cohort of students across two semesters. Consequently, it provides more opportunities for the examination and identification of areas for improvement. In the analyses below, we examine each point at which students who were enrolled in the standard two-term Statway sequence in 2016-2017 failed to complete one part of the pathway or continue into the next.

In 2016-2017, 766 students in standard Statway (47% of those enrolled)¹⁷ (see Figure 6) were unsuccessful in completing the course. Chronologically, there are five primary ways that a student could have failed to succeed:

- Withdrew from the first term of Statway (SW1), and thus did not enroll in the second term of Statway (SW2)
- Completed but failed SW1, and thus did not enroll in SW2
- Succeeded in SW1, but did not enroll in SW2
- Succeeded in SW1, enrolled in SW2, but withdrew from SW2
- Succeeded in SW1, enrolled in SW2, but failed SW2

A very common tool in improvement work is the Pareto chart. The chart is based on the Pareto principle, which states that 80% of any problem stems from 20% of the factors that lead to the problem. A Pareto chart is often used to represent those factors—in this case, categories of failure—sorted from most to least common. The chart typically also has a line showing the cumulative percentage of failures attributed to each of the failure categories. In Table 5 and Figure 7, one can see how common each form of failure is and what contribution it makes to the overall error rate.

¹⁷ The analytic sample for the Pareto analysis includes only standard Statway students for whom a transition from the first to the second course of the sequence was relevant. Students taking the one-term accelerated Statway adaptation were excluded.

Table 5. Categories of Student Failure to Complete the Standard Statway Sequence in 2016-17

| Pareto Categories | Number of Students | Percent of Non-Successful Students |
|--|--------------------|------------------------------------|
| 1. Succeeded in SW1, Did Not Enroll in SW2 | 244 | 36% |
| 2. Failed in SW1 | 237 | 35% |
| 3. Failed in SW2 | 97 | 14% |
| 4. Withdrew in SW1 | 48 | 7% |
| 5. Withdrew in SW2 | 43 | 6% |
| Total | 766 | 100% |

The Pareto chart (adapted from Provost & Murray, 2011) in Figure 7 shows each of these forms of non-success. Light blue bars depict the number of students falling into each category of non-success in the 2016-2017 academic year, and the dark blue line shows the cumulative percentage of students (across the five forms of failure) who did not succeed in the sequence. This analysis helps reveal high-leverage points that are ripe for improvement by researchers, faculty, and college administrators.

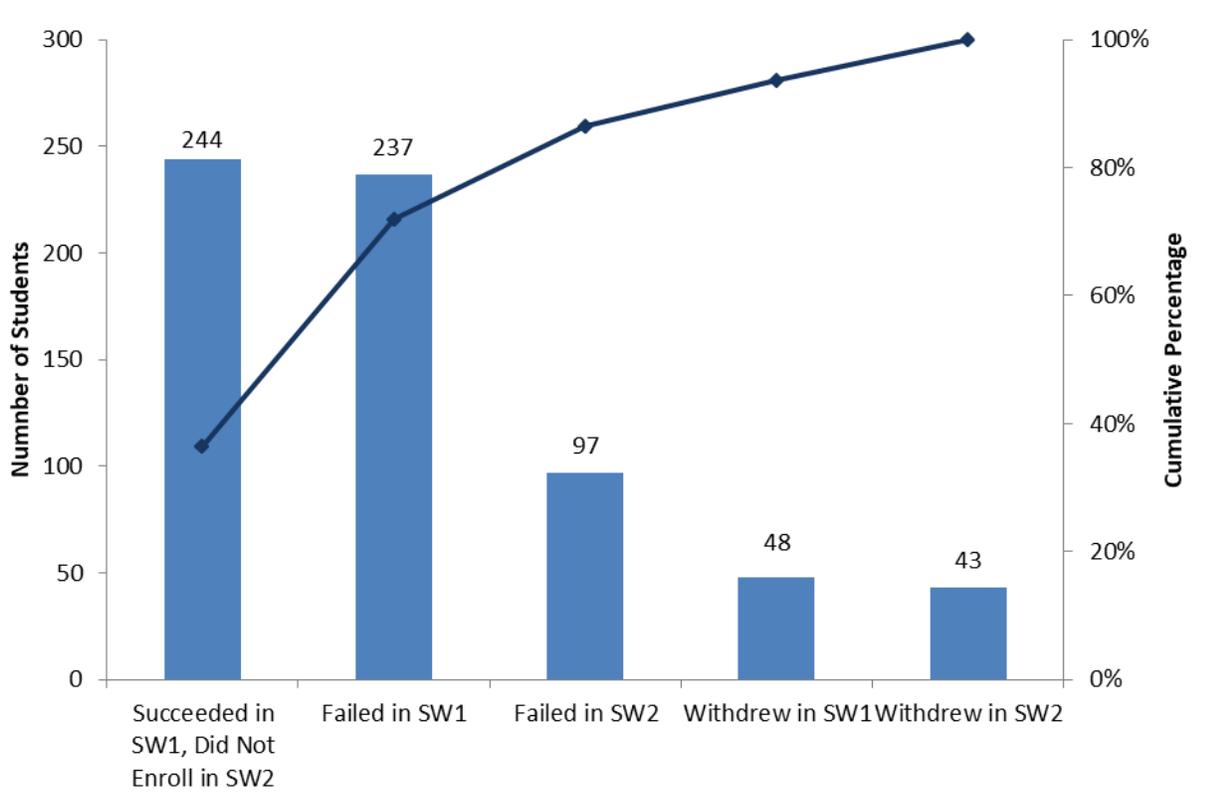


Figure 7. Non-Success in Statway in 2016-2017

First, it is clear that the first and second categories account for the largest percentages of students who fail to complete the standard Statway sequence. We believe both of these failure-to-succeed conditions can be addressed by aspects of our first primary driver: “Accelerated, restructured pathways.” Since the first category describes students who were academically successful in the first term but did not subsequently enroll in the second term, it is important to understand why they

unexpectedly failed to continue the sequence. Does this stem from students' lack of understanding of Statway's structure as a sequence? Are students simply unable to enroll in the second term due to scheduling difficulties? If this is primarily an administrative problem, can processes be developed to improve advising and encourage (or even mandate) enrollment of successful students in the following term? There are positive examples from colleges that have used automatic placement of students who have been successful in the first term to the second term, which can nearly eliminate this failure condition. There are also negative examples in which colleges do not offer the second-semester course at the same time and days as the first term, which can create significant obstacles for students who are working and have little or no flexibility in their schedules. The Pathways team has included evaluation of the sources of failure and possible responses in the implementation supports for institutions.

Complex questions also arise with regard to the second category, which includes students who failed Statway 1. For instance, are there particular characteristics of these students or their contexts that are unique? Can we compare what is being done in classrooms with high and low success rates to understand if there are differences in implementing the primary features of Statway (e.g., active, collaborative learning and socio-emotional supports)? If the intervention works in some classrooms or institutions and not others, can the nature in which these contexts differ be captured to better prepare instructors or improve the materials? The Pathways team is currently testing one response that targets one known pattern of Statway 1 (and Quantway 1) failure—students who are placed in the courses and struggle with some aspects of arithmetic. Several colleges have been working on a set of lessons that address the “big ideas” of arithmetic that would be provided as an additional support in the first weeks of the course. Colleges are testing various forms of delivery (e.g., meeting 30 minutes before each course session, dedicated tutoring in separate sections, etc.). The Pathways team will be reviewing the results from prototype testing in winter 2018 and will be making the lessons available for broad use in fall 2018.

Failure in Statway 2 represents the third-largest category of non-success. While many of the questions surrounding category two apply to this category as well, another point of interest may be to investigate the differences and similarities between students who fail in the first term of Statway and those who fail in the second term of Statway.

Because the percentage of students in the fourth and fifth categories (withdrawing from Statway 1 and withdrawing from Statway 2) are relatively small, these modes of failure may be a lower priority for investigation than the others, at least in the immediate term. As with category one, these data suggest the need to examine the effectiveness of advising and placement for Statway 1 as well as the design and implementation of both Statway 1 and 2. For example, are students dropping the course because they are not receiving enough or the right kind of support? What criteria are being used by advisors to refer students to a Pathways program? It is possible that course failure rates and withdrawals are being driven by inappropriate placement decisions.

Using an improvement approach suggests investigating the practical theory that informed the creation of Statway to determine if that theory needs to be refined to improve the program beyond that which has been realized to date. With this analysis, the Pathways network is well prepared to examine specific aspects of the program and identify priorities for improvement. The Pathways team has great confidence around these efforts. Prior improvement work (e.g., single-term Statway acceleration) has eliminated a source of failure for schools that have implemented it: students exiting the sequence

between the first and second courses of the standard two-term Statway sequence. Classroom interventions to improve attendance and homework completion that were developed, tested, and refined in the NIC are improving course-level success rates. The deliberate application of disciplined improvement techniques continues to improve the overall success of the program.

Conclusion

In the 2016-2017 academic year, the Carnegie Math Pathways program continues to outperform traditional developmental math courses by a wide margin. With institutional changes in one of its largest colleges as well as wider adoption of an accelerated delivery format, Statway success rates have substantially increased in comparison to previous years. A central aspect of this year's improvement work will focus on learning from colleges that have implemented accelerated Statway, among other types of adaptations, to glean insights into how the Pathways can continue to evolve to fit increasingly diverse student and institutional needs. Quantway experienced a similarly dramatic increase in success rates due to the scaling of the program at four-year colleges/universities. Accordingly, another potential direction for research is to illuminate how—aside from different student demographics—the Quantway experience at four-year colleges may differ from that at two-year community colleges. The ultimate goal of these investigations is to discern actionable insights to spread to the rest of the Pathways NIC for continuous improvement.

Overall, Statway and Quantway 1 continue to deliver three to four times the success rate of traditional pathways in half the time. Strikingly, the Pathways managed to uphold these results while expanding its reach to an increasingly diverse range of contexts, suggesting that improvement science has ensured the initiative's effectiveness, even as it spreads and scales. Overall, year six results reinforce the existing evidence that the Pathways can help large numbers of students across an array of contexts acquire mathematics knowledge in pursuit of their academic and career goals.

Participating Institutions in the 2016-2017 Academic Year

STATWAY

American River College
Chippewa Valley Technical College
College of Marin
De Anza College
Diablo Valley College
Foothill College
Kapi'olani Community College
LaGuardia Community College
Los Angeles Pierce College
Minneapolis Community and Technical College
Minnesota State College - Southeast Technical
Mission College
Mt. San Antonio College
Normandale Community College
Renton Technical College
Richland College
Rochester Community and Technical College
San Diego City College
San Jose State University
Seattle Central Community College
South Seattle Community College
Southwestern College
Tacoma Community College
Tallahassee Community College

QUANTWAY

Capital Community College
Chippewa Valley Technical College
Cuyahoga Community College
Fashion Institute of Technology
Kent State University
Laramie County Community College
Madison College
Mohawk Valley Community College
Morrisville State College
Niagara County Community College
Nicolet Area Technical College
Onondaga Community College
Ridgewater College
Rockland Community College
Schenectady County Community College
Sinclair Community College
South Georgia State College
Suffolk County Community College
SUNY Adirondack
SUNY Broome Community College
Tompkins Cortland Community College
University of North Georgia, Gainesville
University of Washington, Bothell
University of Wisconsin-Milwaukee
Westchester Community College

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Appendix

Table A1. Pathways Enrollment, 2016-2017

| | Institutions | Sections | Faculty | Students |
|-----------------|--------------|----------|-------------------|----------|
| Statway | 24 | 168 | 106 | 3,826 |
| Quantway | 25 | 247 | 119 | 3,696 |
| Total | 48 | 415 | 224 ¹⁸ | 7,522 |

The Pathways student body is diverse and includes groups that have been historically underserved in higher education. Both Pathways enroll more females than males and large percentages of minority students. The average age of students is higher than that of a typical entering college student.

Table A2. 2016-2017 Pathways Student Demographics¹⁹

| | Statway (n=3,826) | Quantway (n=3,696) |
|-------------------------------|-------------------|--------------------|
| Sex | | |
| Female | 42% | 44% |
| Male | 25% | 25% |
| Other | <1% | <1% |
| Unknown | 33% | 31% |
| Average Age in Years | | |
| | 25 | 24 |
| Race / Ethnicity | | |
| White | 20% | 37% |
| Hispanic/Latino | 28% | 13% |
| African-American | 8% | 10% |
| Multiracial | 4% | 4% |
| Asian | 4% | 2% |
| Pacific Islander | <1% | <1% |
| American Indian/Alaska Native | <1% | 1% |
| Other | 3% | 2% |
| Unknown | 33% | 31% |

¹⁸ The total number of unique Pathways faculty does not equal the sum of the total number of unique Statway faculty and the total number of unique Quantway faculty, because one instructor taught both Statway and Quantway.

¹⁹ Demographic data in previous impact reports were provided by institutional researchers at participating colleges. Starting in 2015-2016, these data were self-reported by students on a survey distributed at the beginning of the course. Over 30% of students did not complete demographic items on the survey, indicating the need to explore new ways of increasing the response rate to more accurately understand the Pathways student body.

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Table A3. Statway Enrollment and Success, Fall 2011 to Fall 2016

| | | Colleges | SW1 Enroll | SW1 Complete | SW1 Success | SW2 Enroll | SW2 Complete | SW2 Success | SW1 Enroll | SW1 Complete | SW1 Success | SW2 Enroll | SW2 Complete | SW2 Success |
|---------------------------------|----------|----------|---------------|-----------------|----------------|---------------|-----------------|----------------|---------------|-----------------|----------------|---------------|-----------------|----------------|
| Fall 2011 Cohort | CCs* | 18 | 968 | 890 | 649 | 563 | 523 | 468 | 100% | 92% | 67% | 58% | 54% | 48% |
| | CSUs | 2 | 152 | 151 | 130 | 121 | 119 | 99 | 100% | 99% | 86% | 80% | 78% | 65% |
| | Combined | 20 | 1,120 | 1,041 | 779 | 684 | 642 | 567 | 100% | 93% | 70% | 61% | 57% | 51% |
| Fall 2012 Cohort | CCs | 18 | 853 | 774 | 603 | 524 | 501 | 445 | 100% | 91% | 71% | 61% | 59% | 52% |
| | CSUs | 4 | 204 | 199 | 180 | 170 | 167 | 153 | 100% | 98% | 88% | 83% | 82% | 75% |
| | Combined | 22 | 1,057 | 973 | 783 | 694 | 668 | 598 | 100% | 92% | 74% | 66% | 63% | 57% |
| Fall 2013 Cohort | CCs | 19 | 1,294 | 1,115 | 887 | 788 | 716 | 620 | 100% | 86% | 69% | 61% | 55% | 48% |
| | CSUs | 3 | 141 | 140 | 131 | 122 | 122 | 117 | 100% | 99% | 93% | 87% | 87% | 83% |
| | Combined | 22 | 1,435 | 1,255 | 1,018 | 910 | 838 | 737 | 100% | 87% | 71% | 63% | 58% | 51% |
| Fall 2014 Cohort | CCs | 16 | 1,391 | 1,206 | 922 | 815 | 730 | 652 | 100% | 87% | 66% | 59% | 52% | 47% |
| | CSUs | 2 | 94 | 93 | 81 | 74 | 74 | 68 | 100% | 99% | 86% | 79% | 79% | 72% |
| | Combined | 18 | 1,485 | 1,299 | 1,003 | 889 | 804 | 720 | 100% | 87% | 68% | 60% | 54% | 48% |
| Fall 2015 Cohort | CCs | 20 | 2,467 | 2,196 | 1,656 | 1,394 | 1,335 | 1,212 | 100% | 89% | 67% | 57% | 54% | 49% |
| | CSUs | 1 | 64 | 61 | 57 | 55 | 54 | 51 | 100% | 95% | 89% | 86% | 84% | 80% |
| | Combined | 21 | 2,531 | 2,257 | 1,713 | 1,449 | 1,389 | 1,263 | 100% | 89% | 68% | 57% | 55% | 50% |
| Fall 2016 Cohort | CCs | 21 | 2,816 | 2,655 | 2,098 | 1,863 | 1,819 | 1,725 | 100% | 94% | 75% | 66% | 65% | 61% |
| | CSUs | 1 | 75 | 75 | 66 | 58 | 58 | 55 | 100% | 100% | 88% | 77% | 77% | 73% |
| | Combined | 22 | 2,891 | 2,730 | 2,164 | 1,921 | 1,877 | 1,780 | 100% | 94% | 75% | 66% | 65% | 62% |

Table A3 (continued). Statway Enrollment and Success, Fall 2011 to Fall 2016

| | Colleges | SW1 Enroll | SW1 Complete | SW1 Success | SW2 Enroll | SW2 Complete | SW2 Success | SW1 Enroll | SW1 Complete | SW1 Success | SW2 Enroll | SW2 Complete | SW2 Success | |
|--------------|----------|---------------|-----------------|----------------|---------------|-----------------|----------------|---------------|-----------------|----------------|---------------|-----------------|----------------|-----|
| | CCs | 34 | 9,789 | 8,836 | 6,815 | 5,947 | 5,122 | 5,122 | 100% | 90% | 70% | 61% | 57% | 52% |
| Total | CSUs | 5 | 730 | 719 | 645 | 600 | 594 | 543 | 100% | 98% | 88% | 82% | 81% | 74% |
| | Combined | 39 | 10,519 | 9,555 | 7,460 | 6,547 | 6,218 | 5,665 | 100% | 91% | 71% | 62% | 59% | 54% |

Table A4. Quantway 1 Enrollment and Success, Spring 2012 to Spring 2017

| | Colleges | Enroll | Complete | Success | Enroll | Complete | Success |
|------------------|----------|--------|----------|---------|--------|----------|---------|
| 2011-2012 | 8 | 418 | 346 | 234 | 100% | 83% | 56% |
| 2012-2013 | 8 | 1,402 | 1,180 | 732 | 100% | 84% | 52% |
| 2013-2014 | 11 | 1,805 | 1,536 | 1,062 | 100% | 85% | 59% |
| 2014-2015 | 10 | 1,936 | 1,516 | 1,107 | 100% | 78% | 57% |
| 2015-2016 | 16 | 2,680 | 2,360 | 1,724 | 100% | 88% | 64% |
| 2016-2017 | 23 | 3,227 | 3,083 | 2,310 | 100% | 96% | 72% |
| Total | 16 | 11,468 | 10,021 | 7,169 | 100% | 87% | 63% |

Table A5. Quantway 2 Enrollment and Success, Spring 2013 to Spring 2017

| | Colleges | Enroll | Complete | Success | Enroll | Complete | Success |
|------------------|----------|--------|----------|---------|--------|----------|---------|
| 2012-2013 | 3 | 44 | 42 | 30 | 100% | 95% | 68% |
| 2013-2014 | 3 | 217 | 187 | 145 | 100% | 86% | 67% |
| 2014-2015 | 3 | 168 | 132 | 96 | 100% | 79% | 57% |
| 2015-2016 | 5 | 286 | 256 | 193 | 100% | 90% | 67% |
| 2016-2017 | 7 | 814 | 800 | 624 | 100% | 98% | 77% |
| Total | 5 | 671 | 575 | 434 | 100% | 86% | 65% |

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