CARNEGIE MATH
PATHWAYS

Implementing Mathematics Pathways, Part II – Institution and Classroom Level Strategies

Statway and Quantway

MAA 2017

Carnegie Foundation
for the Advancement of Teaching

Presenters

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How can we radically transform outcomes for ALL students in (developmental) mathematics?

Persistence
Quality of learning
Identities as learners
Completion and beyond

1. How can we design course structures for the realities of our students' lives in order to give them the best chance for success?

2. How can we best support powerful mathematics learning and students' persistence and engagement?

3. How can student success outcomes be sustained and improved?

The Problem

60-70%

of community college students need at least one developmental math course before enrolling in college-credit courses

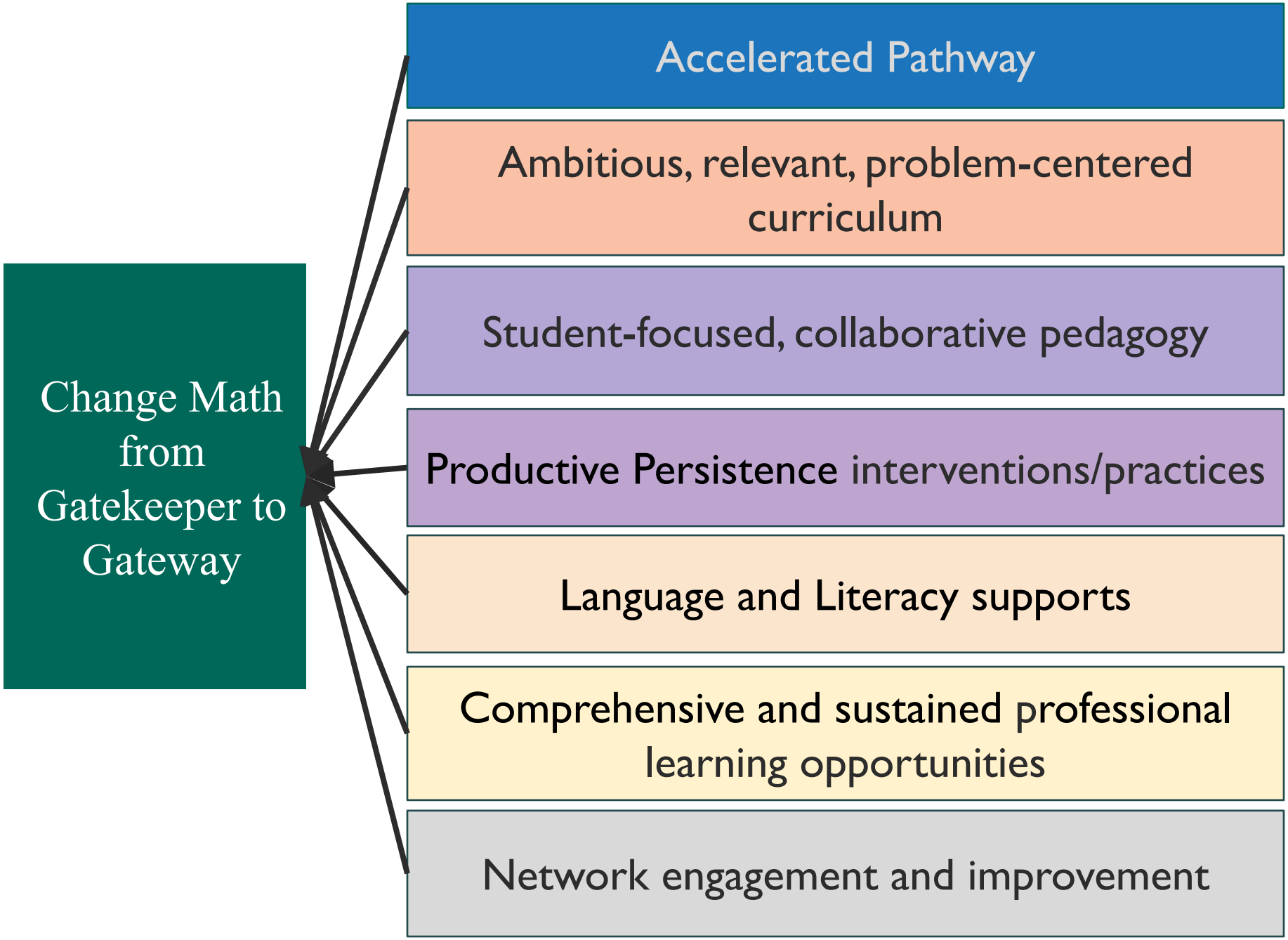
80%

of those students never get out of the developmental math pathway

500,000 students

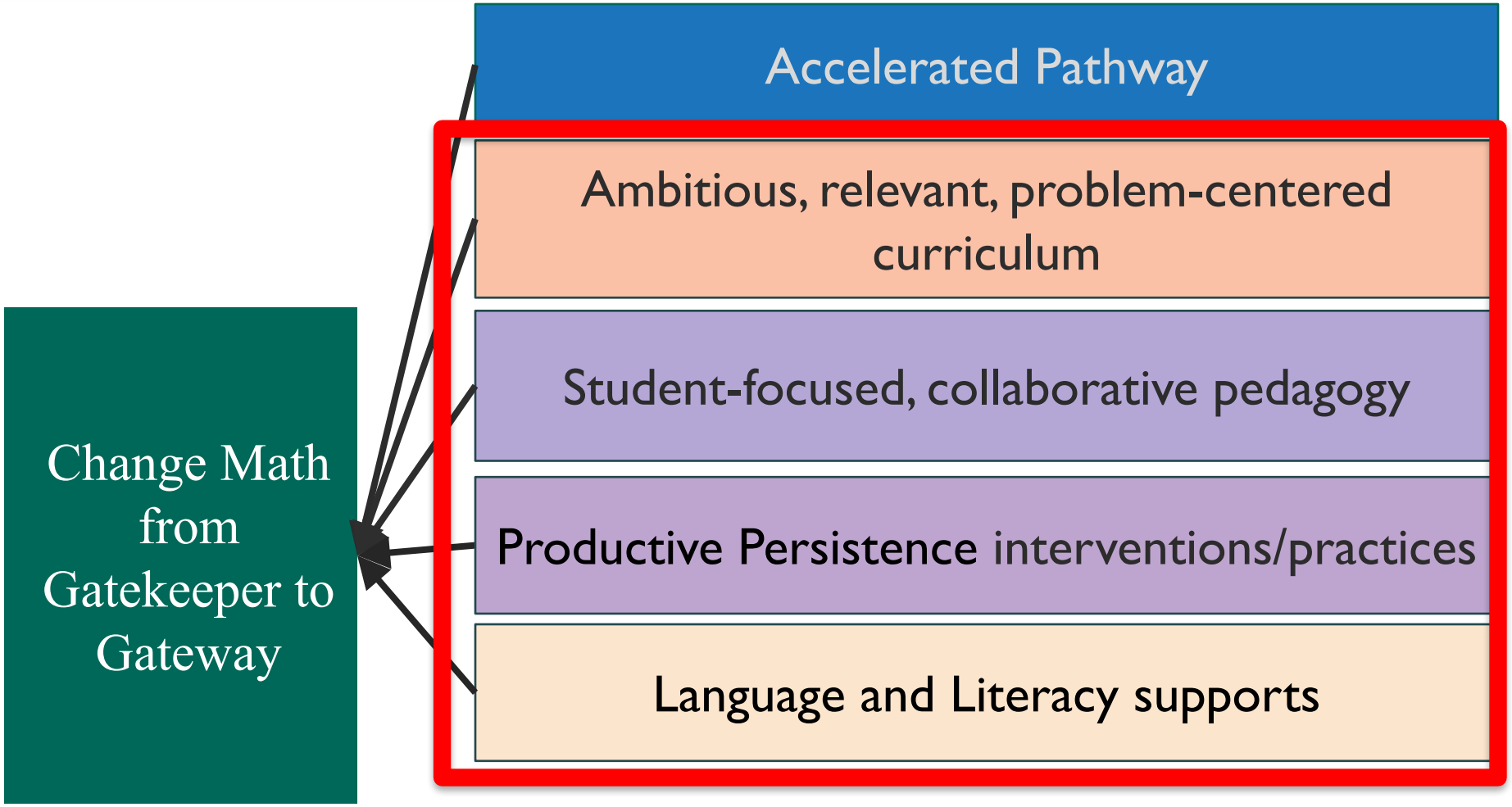
in every cohort will never complete the math requirement

We cannot continue to use the same approach and expect different results.


Change Math from Gatekeeper to Gateway
Accelerated Pathway
Ambitious, relevant, problem-centered curriculum
Student-focused, collaborative pedagogy
Productive Persistence interventions/practices
Language and Literacy supports
Comprehensive and sustained professional learning opportunities
Network engagement and improvement

Accelerated Pathway

Change Math from Gatekeeper to Gateway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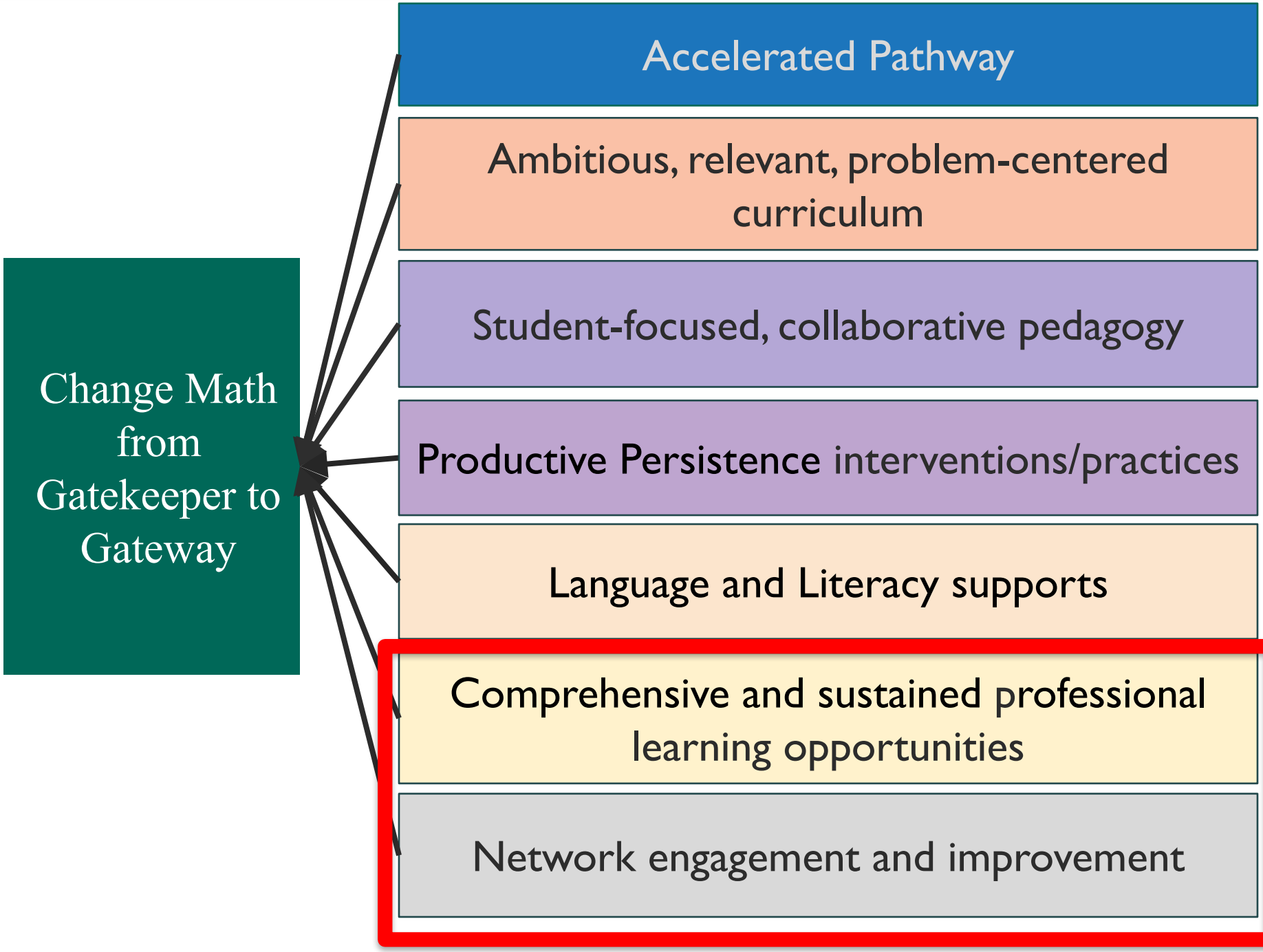
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Statway and Quantway

In classrooms **since 2011**

Now in over **60 institutions** across the country

More than **20,000 students** served

6% of students earn college credit in 1 year in the traditional math sequence.

15% of students earn college credit in 2 years in the traditional math sequence.

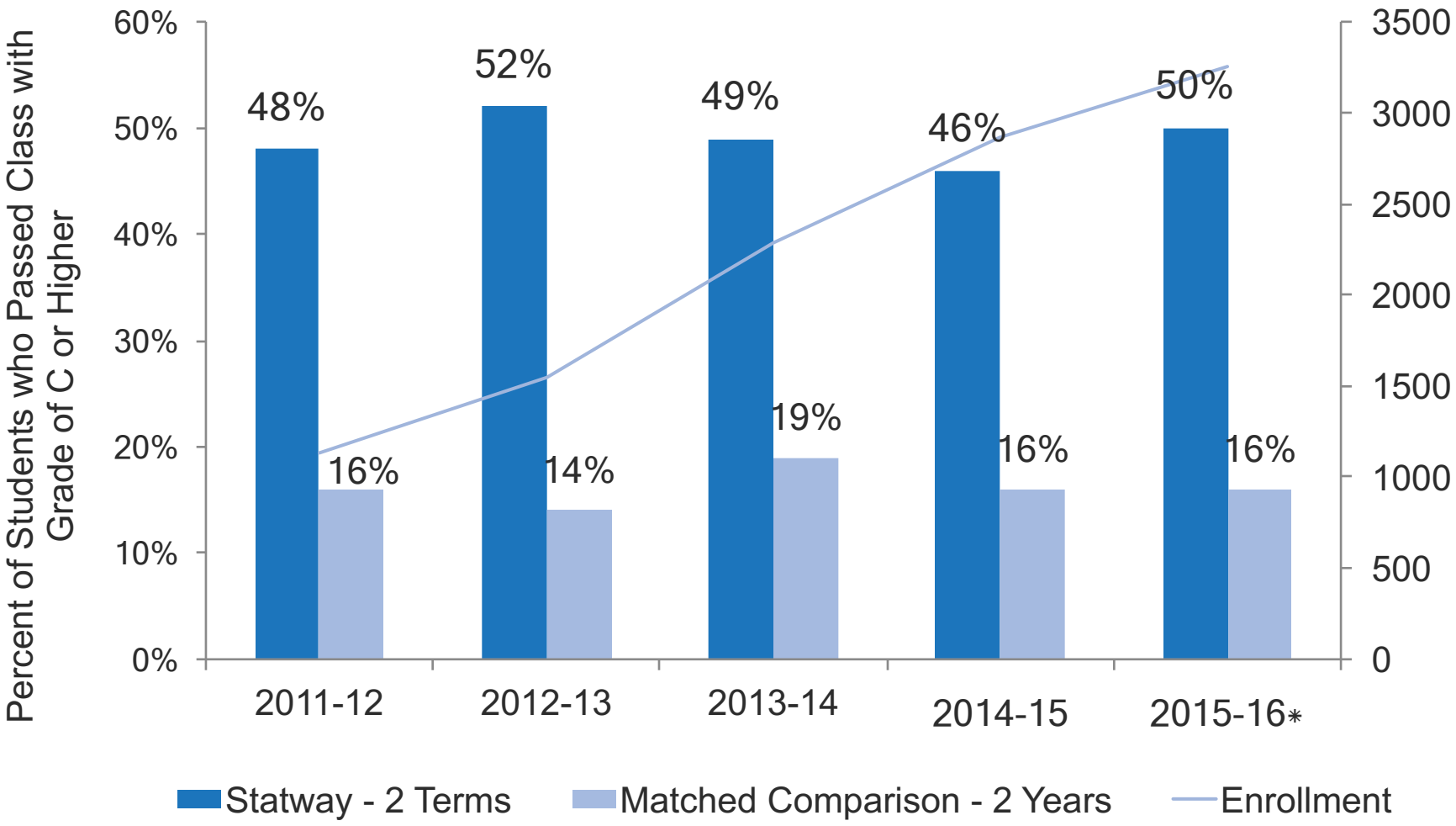
48% of students earn college credit in a single year in Statway.

Triple the success in half the time

1 Huang, M., Hoang, H., Yesilyurt, S., & Thorn, C. (2016). *Community College Pathways: 2014-2015 Impact Report.* Stanford, CA: Carnegie Foundation for the Advancement of Teaching.

Triple the Success in Half the Time

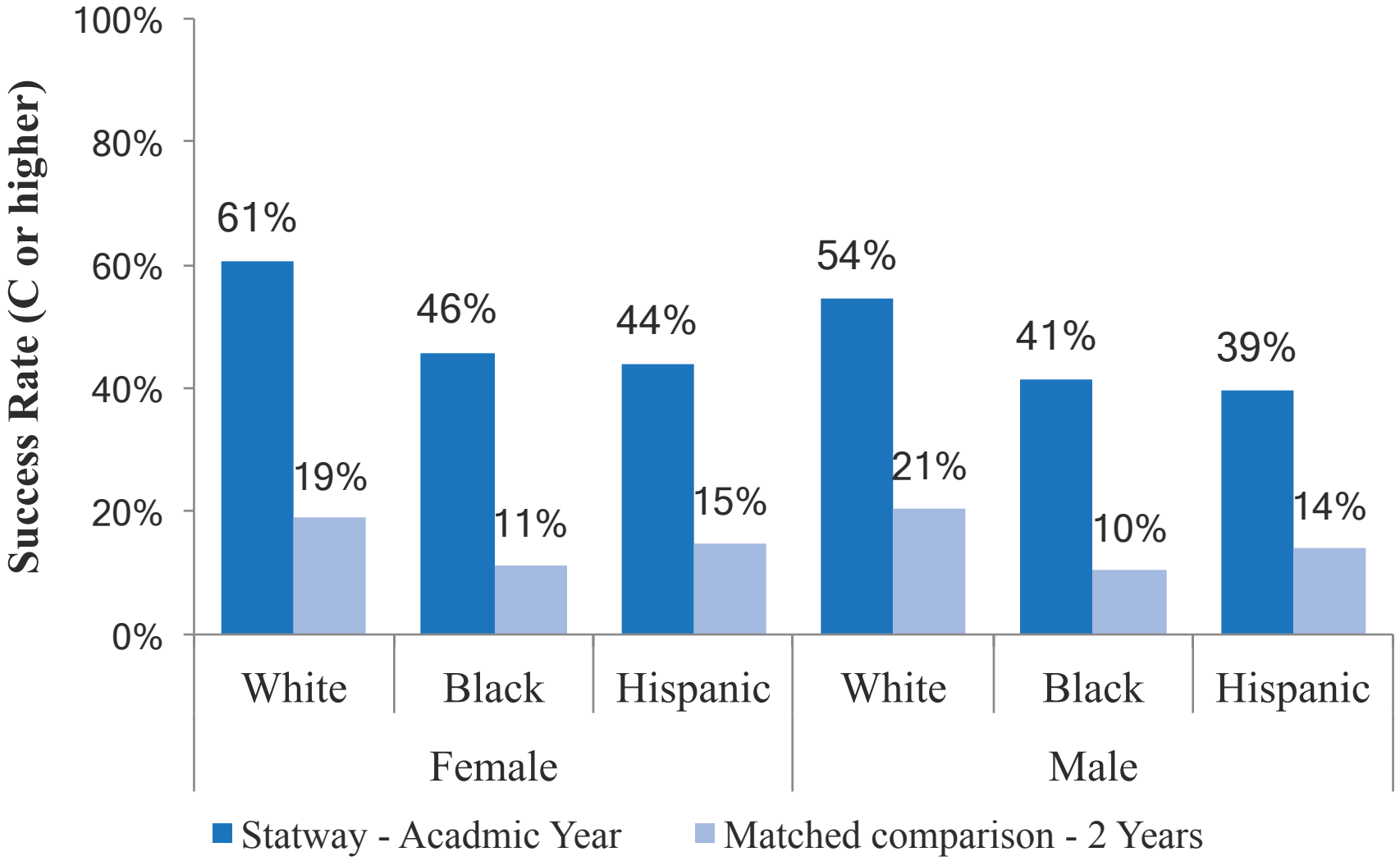
Statway



* 2015-16 Statway data are from the Year 5 Descriptive Report and comparison data are estimated

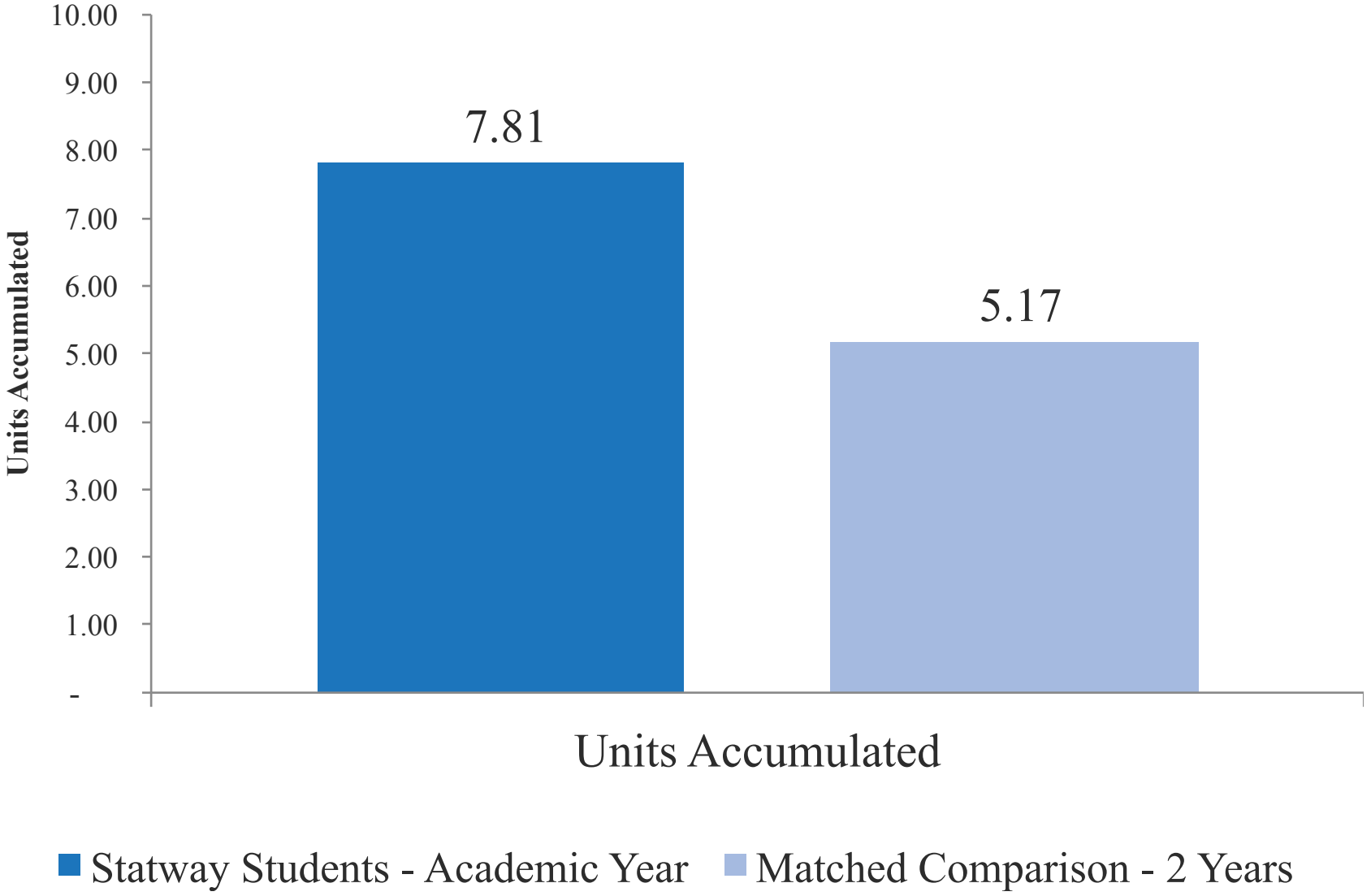
Advancing Equity – Improving Outcomes For Diverse Subgroups

Statway

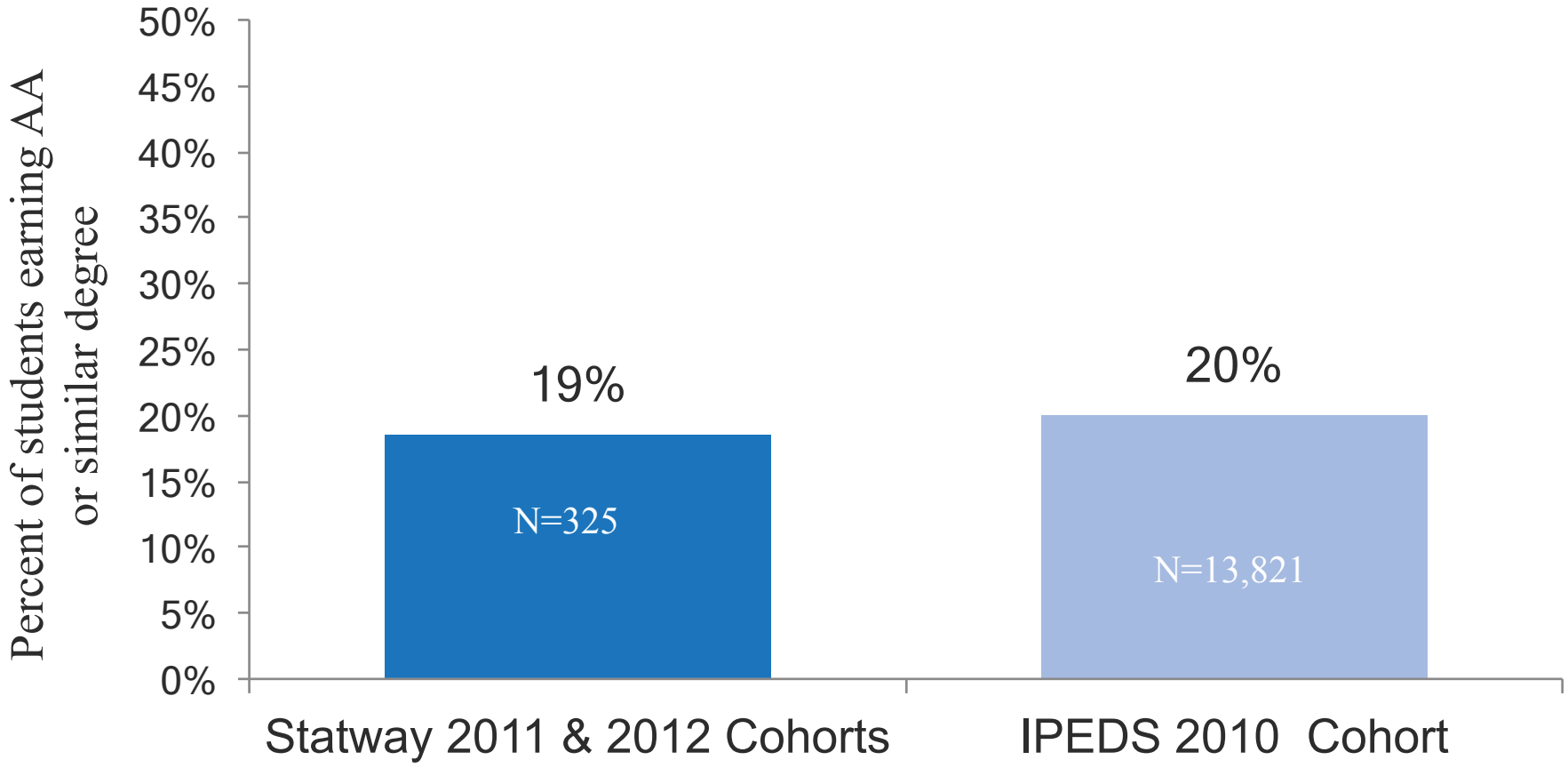


College credit accumulation and post-participation outcomes for statway students

On average, Statway students accumulate comparable college level units in the subsequent calendar year

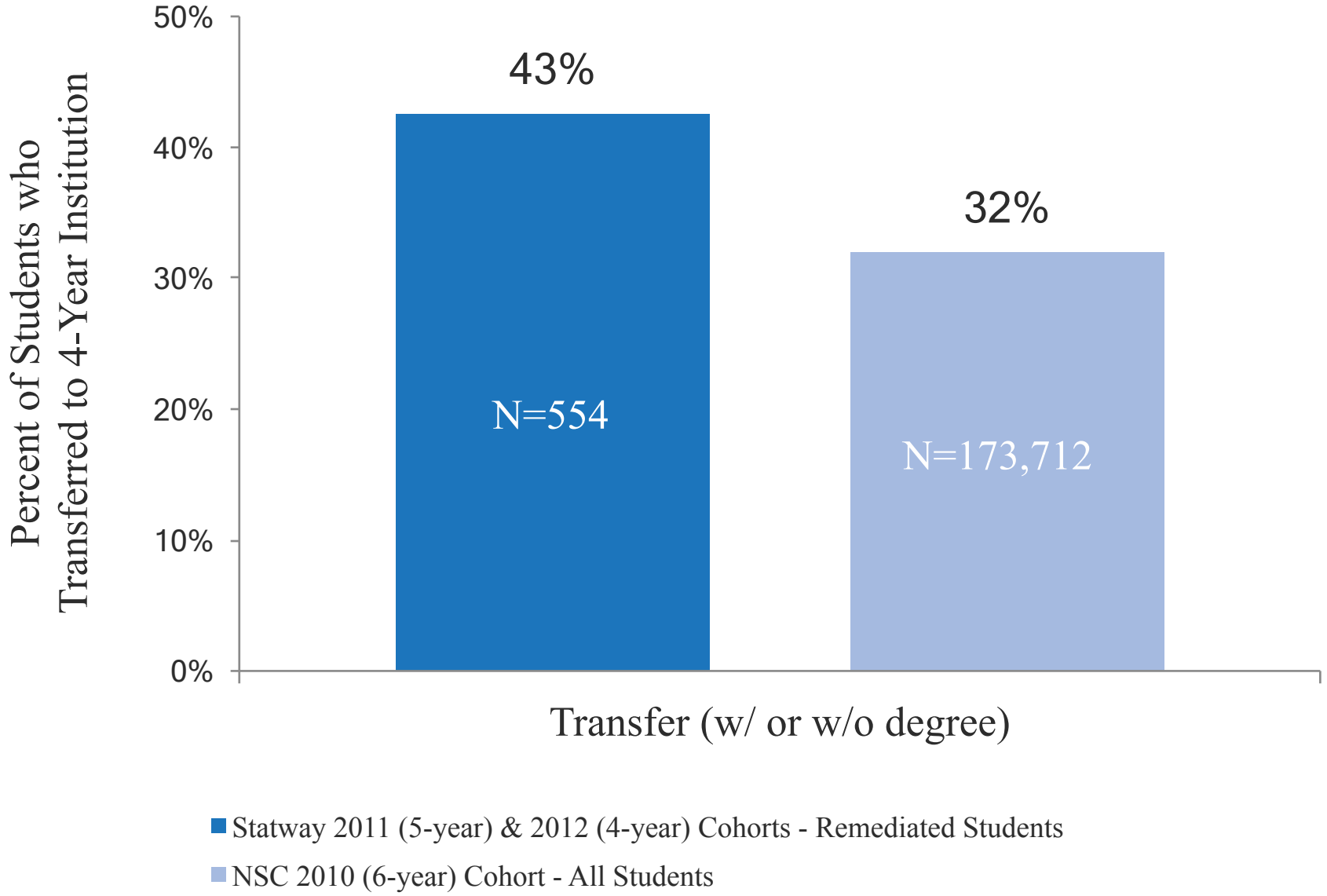


Statway students earn AA or other 2 year credentials at about the same rate as other students at the SAME schools



Proportion of Students who Received AA or other Credential at Statway Schools. Both groups are 4 year cohort results. Statway is remediated students only. IPEDS cohorts are all students.

Statway students are more likely to transfer to 4-year institutions compared to students at large



Aggregate Results in Upper Division Courses by Cohort

Cohort (n)	SW (UNVS 15A/B/C) (29)	MATH 3A/B (109)
UD Course Attempts	42	135
Ave GPA for UD Courses	3.33	2.66
Standard Deviation of Ave GPA for UD Courses	0.95	1.11
% Passed UD Courses with "C or Better" (not C-)	93%	81%

Difference in GPA is statistically significant ($p<.01$)

Withdrawals and incompletes are excluded from the analysis shown here, but would not substantially change the results. Also excluded are students who "crossed over" and took both Math 3A/B and Statway.

21% of students complete developmental math requirement in 1 term in the traditional math sequence.

29% of students complete developmental math requirement in 2 terms in the traditional math sequence.

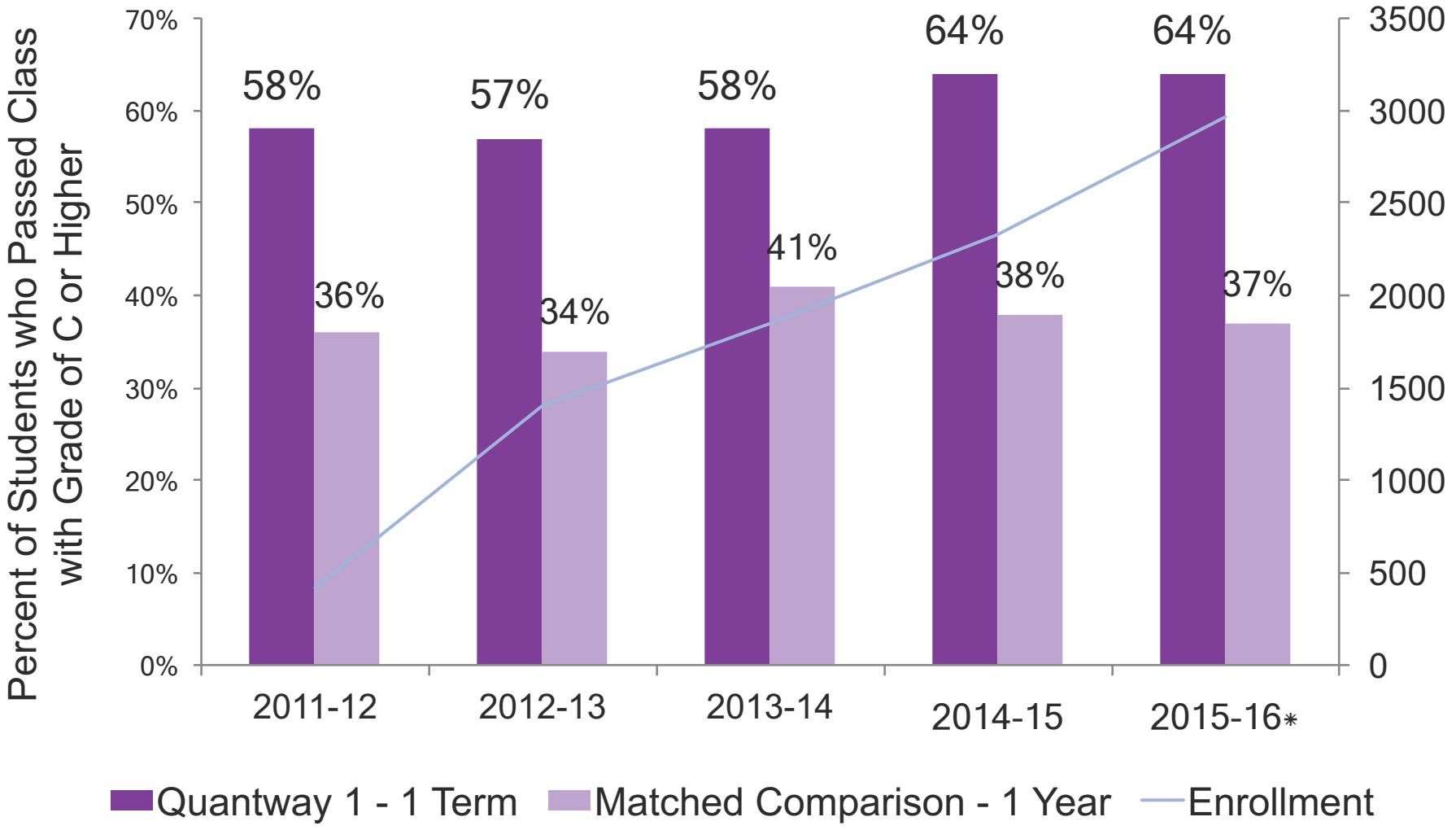
56% of students complete developmental math requirement in 1 term in Quantway 1.

Nearly double the success in half the time

1 Huang, M., Hoang, H., Yesilyurt, S., & Thorn, C. (2016). *Community College Pathways: 2014-2015 Impact Report.* Stanford, CA: Carnegie Foundation for the Advancement of Teaching.

Nearly Twice the Success in Half the Time

Quantway



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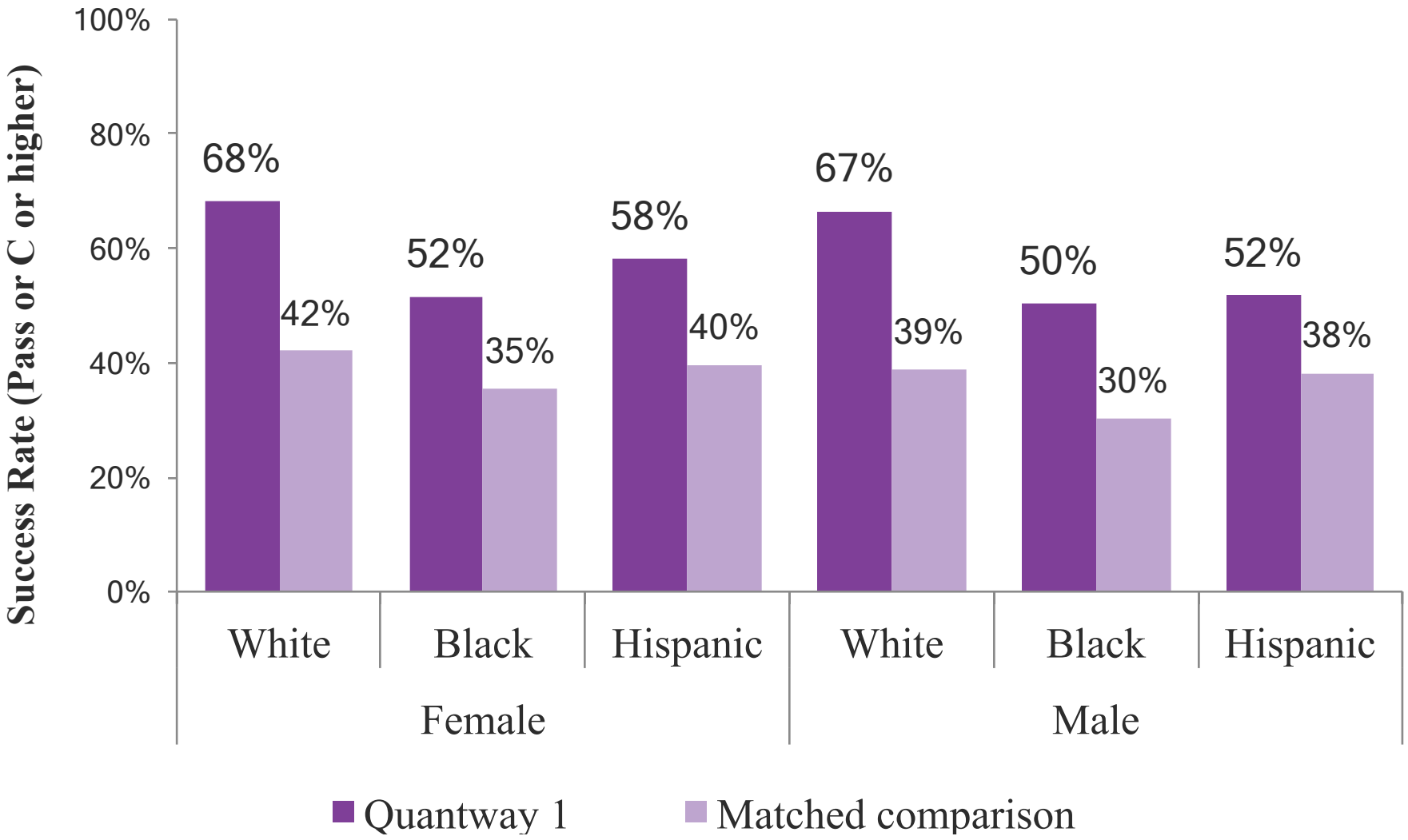
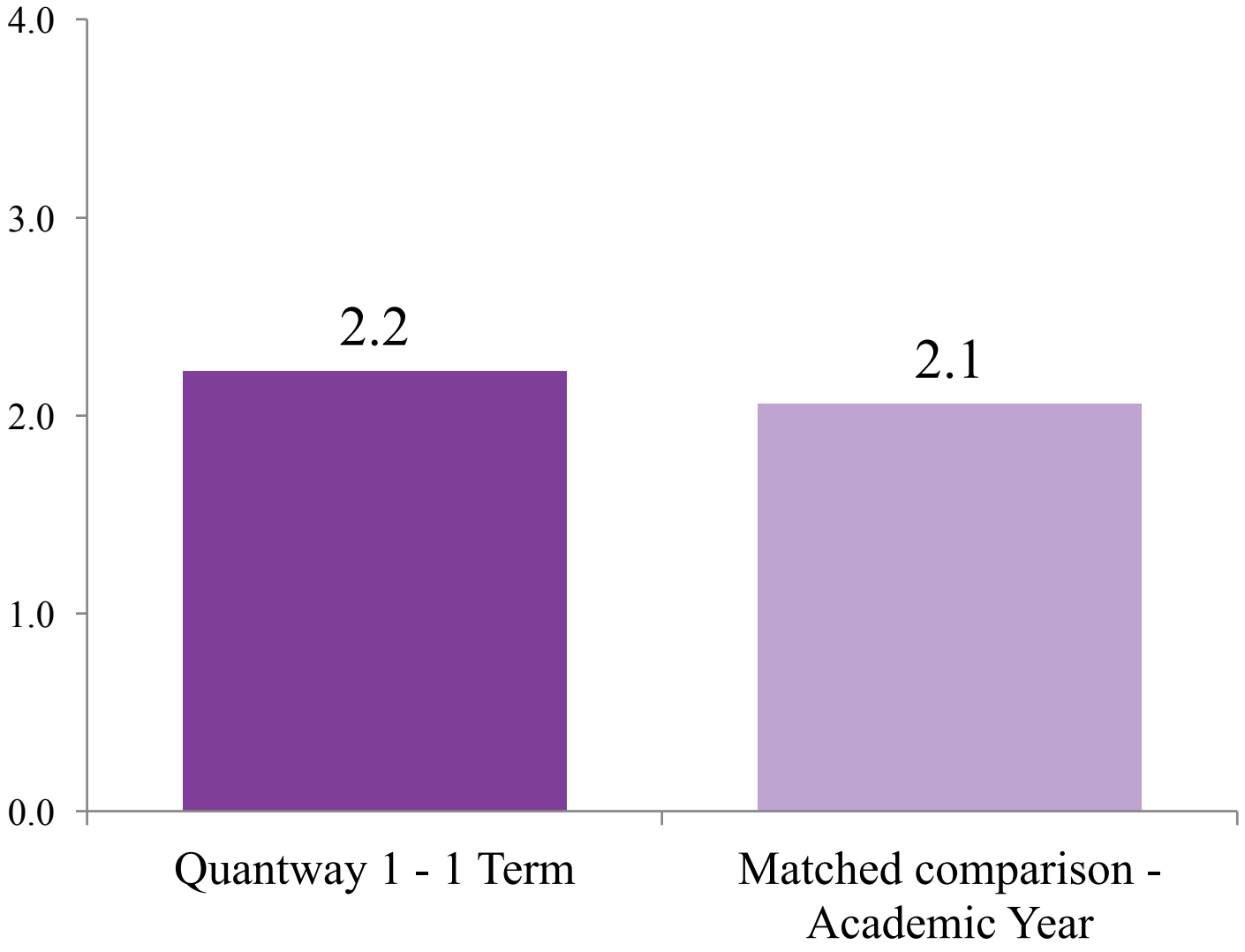
Quantway 1: Advancing Equity - Major Gains Across All Subgroups



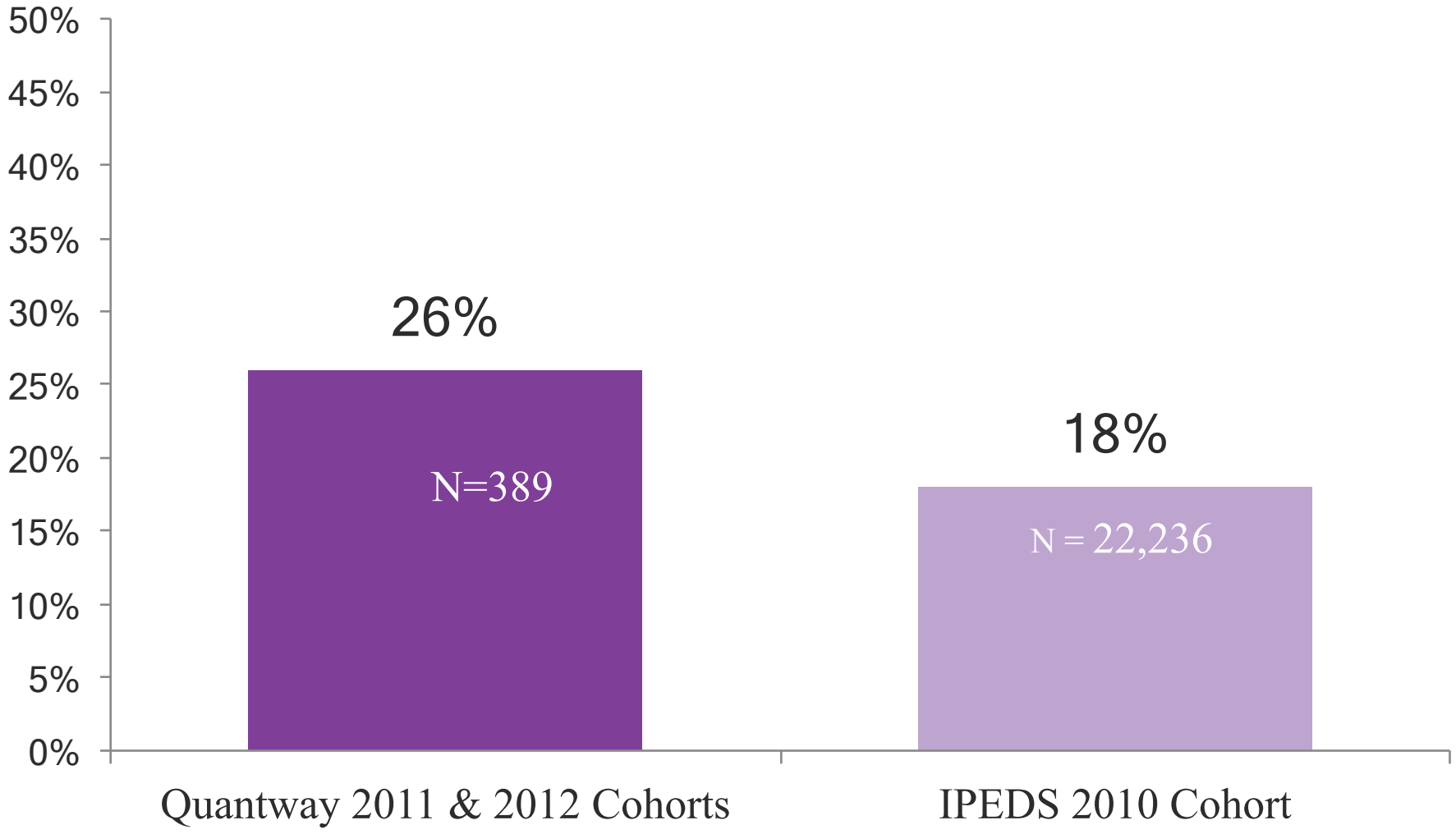
Data are aggregated across 4 matched cohorts - 2011-12 through 2014-15. For an in-depth description of this analysis see Yamada, H. & Bryk, A. (2016). Assessing the First Two Years' Effectiveness of Statway®: A Multilevel Model With Propensity Score Matching. Community College Review, July, 44(3), 179-204. See also Huang, M. & Yamada, H. (forthcoming) Assessing the Effectiveness of Statway in 2013-15: A Multilevel Model with Propensity Score Matching. Carnegie Foundation for the Advancement of Teaching: Stanford, CA.

College-level math course grades and post-participation outcomes for Quantway students

Quantway 1
Students demonstrate a comparable GPA on college math



Quantway 1 students earn AA or other 2 year credentials at about a slightly higher rate compared to students at the SAME schools



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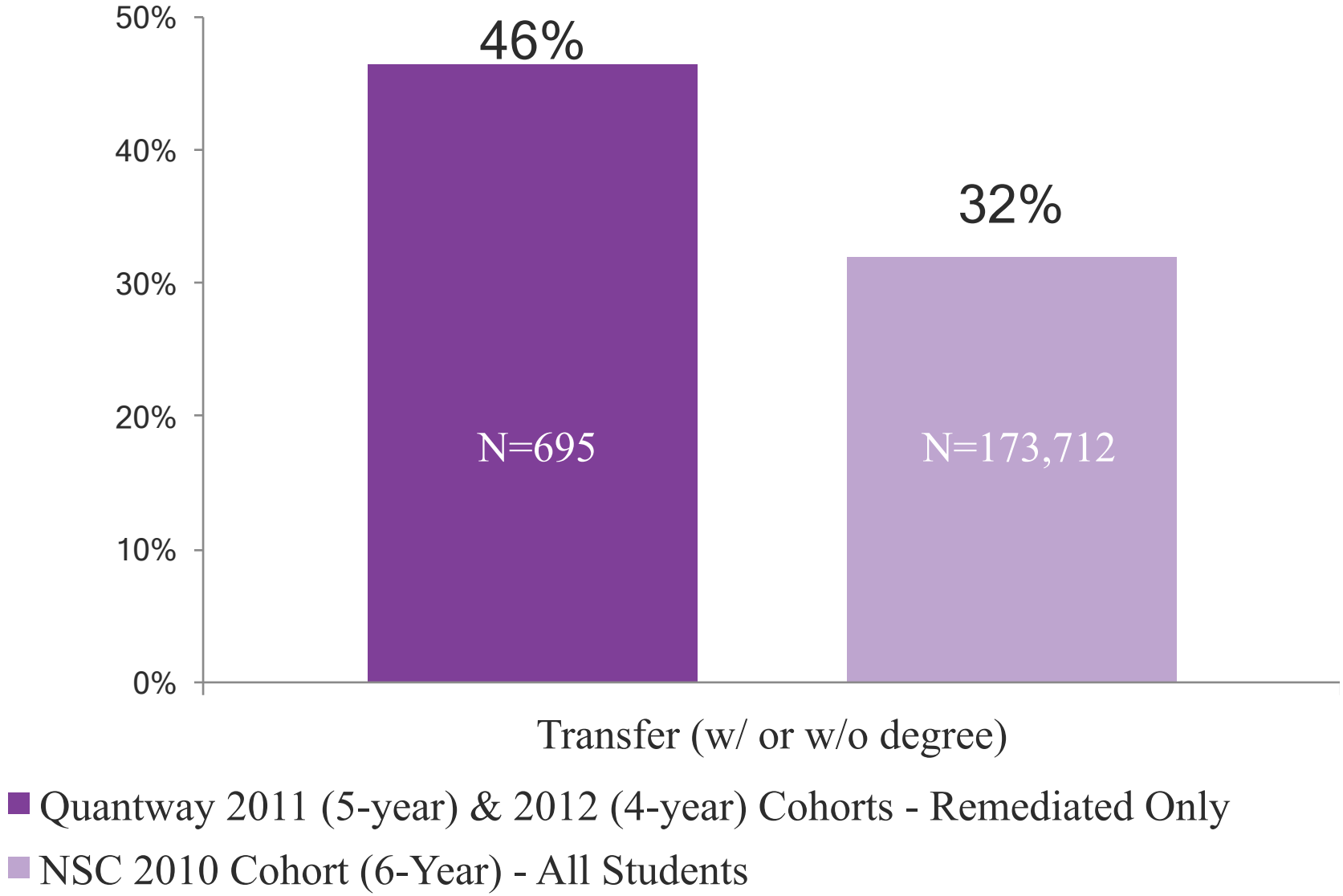
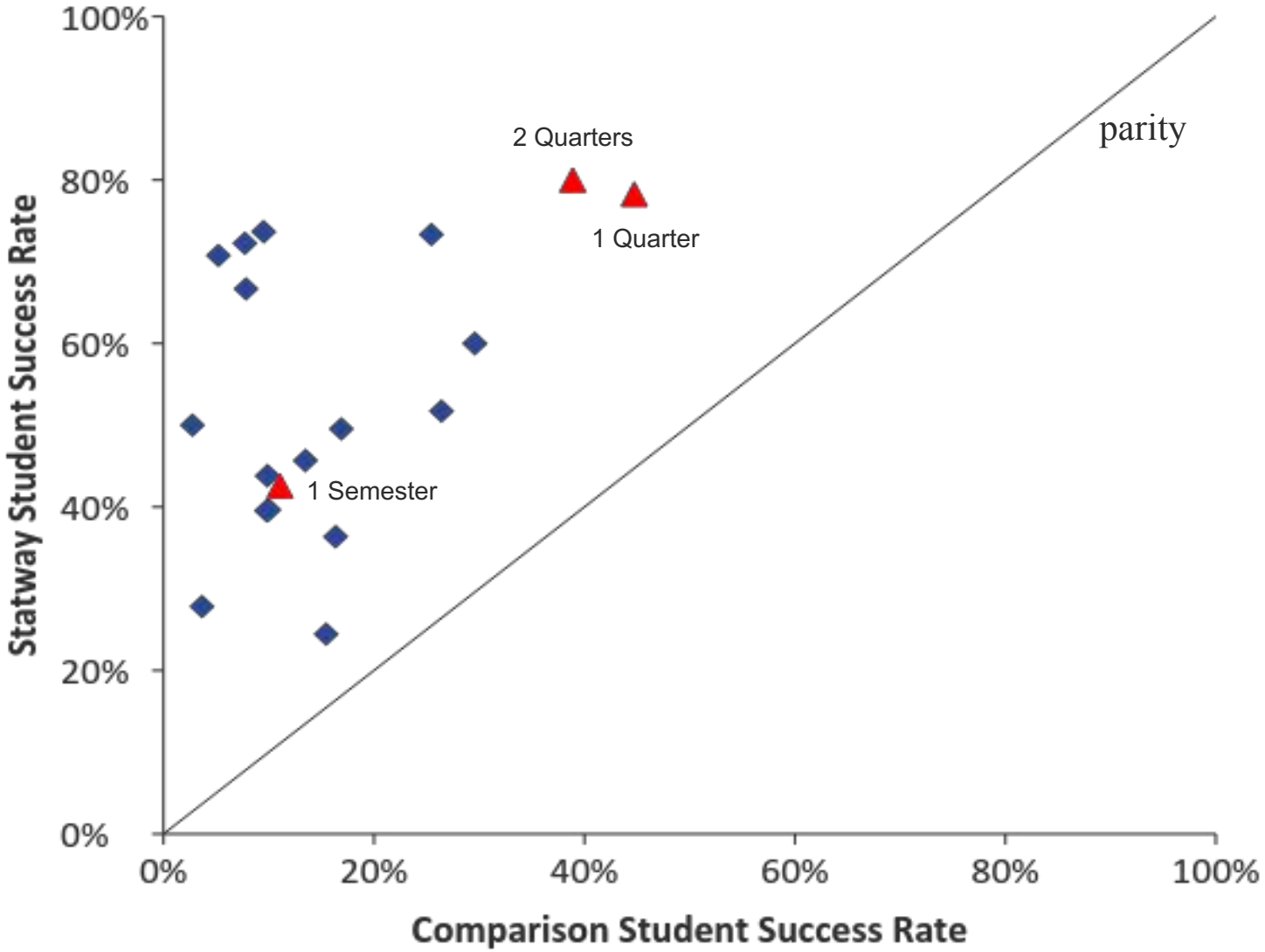


Statway Outperforms Comparison Group at **Every** College



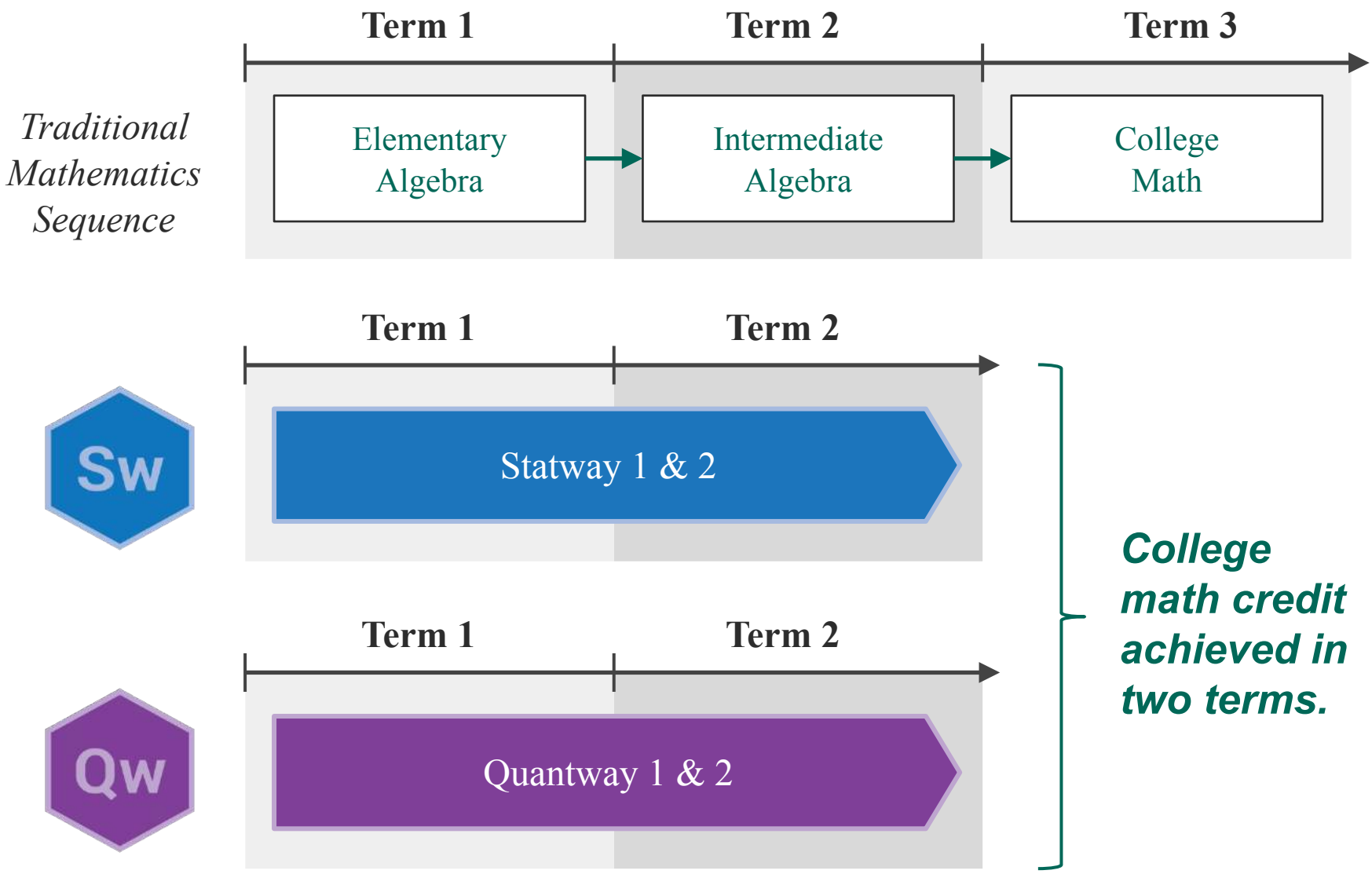
1. How can we design course structures for the realities of our students' lives in order to give them the best chance for success?

Acceleration:

Shorten the sequence

Reduce transition points

A Solution: Coherent, Intensive Learning Pathways



Bridge to STEM – Responding to Demand

- A set of lessons that addresses learning objectives that would be covered in order to prepare students to enter college algebra, business math, and pre-calculus.
- Can be flexibly applied at colleges.
- Designed with the same instructional design principles as Statway and Quantway.

North Hennepin Community College

SACRAMENTO STATE

Richland College
DALLAS COUNTY COMMUNITY COLLEGE DISTRICT

SAN JOSÉ STATE UNIVERSITY

UNIVERSITY of WASHINGTON BOTHELL

SGSC South Georgia State College

1. How can we design course structures for the realities of our students' lives in order to give them the best chance for success?

Acceleration:

Shorten the sequence

Reduce transition points

Cohort Model:

Keep students together

2. How can we best support powerful mathematics learning and students' persistence and engagement?

Make curriculum productively challenging and relevant to students' lives

Mathematics Learned in Context

- Students learn mathematics and statistics through the exploration of *problem situations* – contextual problems that require and involve the use of mathematical or statistical concepts and procedures.
- Real-world contexts include:
  - Gun Violence
  - National Elections
  - Citizenship
  - Environment
  - Personal Finance
  - Information Technology
  - Sports

Comparable Concepts

Calculate the standard deviation of the following ten numbers:

$3.58

$5.12

$10.25

$31.18

$6.75

….

Traditional Problem

A class conducted a survey of how students spend their money. They asked 25 students to estimate how much money they typically spend each week on fast food. They determined that the mean amount spent on fast food is $31.52 with a standard deviation of $21.60. Later they realized that a value entered as $3 should have been $30. They recalculate the mean and standard deviation. The mean is now $32.60. Which of the following is true about the standard deviation (SD)?

1. The SD will increase, because we have increased the value of a data point.

2. The SD will stay the same, because the standard deviation is not affected by a change in a single measurement.

3. The SD will decrease, because this change moved a data point closer to the mean.

Statway Problem

Comparable Concepts

Find the equation of the line passing through the points

(2,-4) and (-3,7).

Write the equation in slope-intercept form.

Traditional Problem

You want to have your own phone and need to decide which option costs less. Note that the descriptions of these options are examples of verbal representations of the mathematical relationships.

- Per-Minute Pricing: There is a monthly fee of $15.99 plus $0.13 per minute.
- Unlimited Plan: The plan costs $39.99 per month. The phone is free and unlimited minutes of talk time are included, but a two-year contract is required.

Find linear models to help you decide.

Quantway Problem

2. How can we best support powerful mathematics learning and students' persistence and engagement?

Make curriculum productively challenging and relevant to students' lives

Employ instruction that promotes development of flexible expertise and engages students actively and collaboratively

We learn by doing…

NOT by watching!

At times, our students may feel like they will never get it. The truth is, when they struggle, it's not a sign that they can't cut it. Usually, it's a sign that they're learning!

What Do We Want Our Students to Learn?

- *Flexible* vs. *routine* expertise (Hatano & Inagaki)
- What is flexible expertise?
  - Procedural fluency
  - Conceptual understanding
  - Disposition to think/make sense of mathematics
  - Ability to nimbly bring knowledge to bear across a wide array of new situations

Research Indicates Three Critical Learning Opportunities

To achieve flexible expertise, students need recurring and sustained opportunities for:

- *Productive struggle* – with important mathematics
- *Explicit connections* – between concepts, procedures, problems, situations
- *Deliberate practice* – increasing variation and complexity over time

Experience Pathways Lessons

Task:

- Statway 3.1.1 – Complete Questions 1 – 4. Discuss and answer each question working within your group.
- Quantway 1.6 - Complete Questions 1 – 4. Discuss and answer each question working within your group.

Discussion Questions:

- What are the underlying mathematical or statistical concepts & procedures being introduced?
- How are these lessons similar or different than the mathematics lessons that you teach?

My experience has been positive. You know, I **struggled** with it..., but I think that's just a main part of it. You're supposed to jump in and figure it out!

Having a small group allows you to have more contact with the people around you - not necessarily having to raise your hand or be on the spot in front of the whole class. Your questions can get answered a little quicker, you can come to an **understanding with your peers** quicker. I think it's great.

2. How can we best support powerful mathematics learning and students' persistence and engagement?

Make curriculum productively challenging and relevant to students' lives

Employ instruction that promotes development of flexible expertise and engages students actively and collaboratively

Integrate productive persistence into math curriculum and pedagogy

Productive Persistence

Key Question:

- How can we shift students' **mindsets** about mathematics and about themselves as learners and doers of mathematics to positively impact student success in mathematics?

Productive Persistence

Aim:
Students continue to put forth effort during challenges and when they do so they use effective strategies.

Students believe they are capable of learning math.

Students feel socially tied to peers, faculty, and the course.

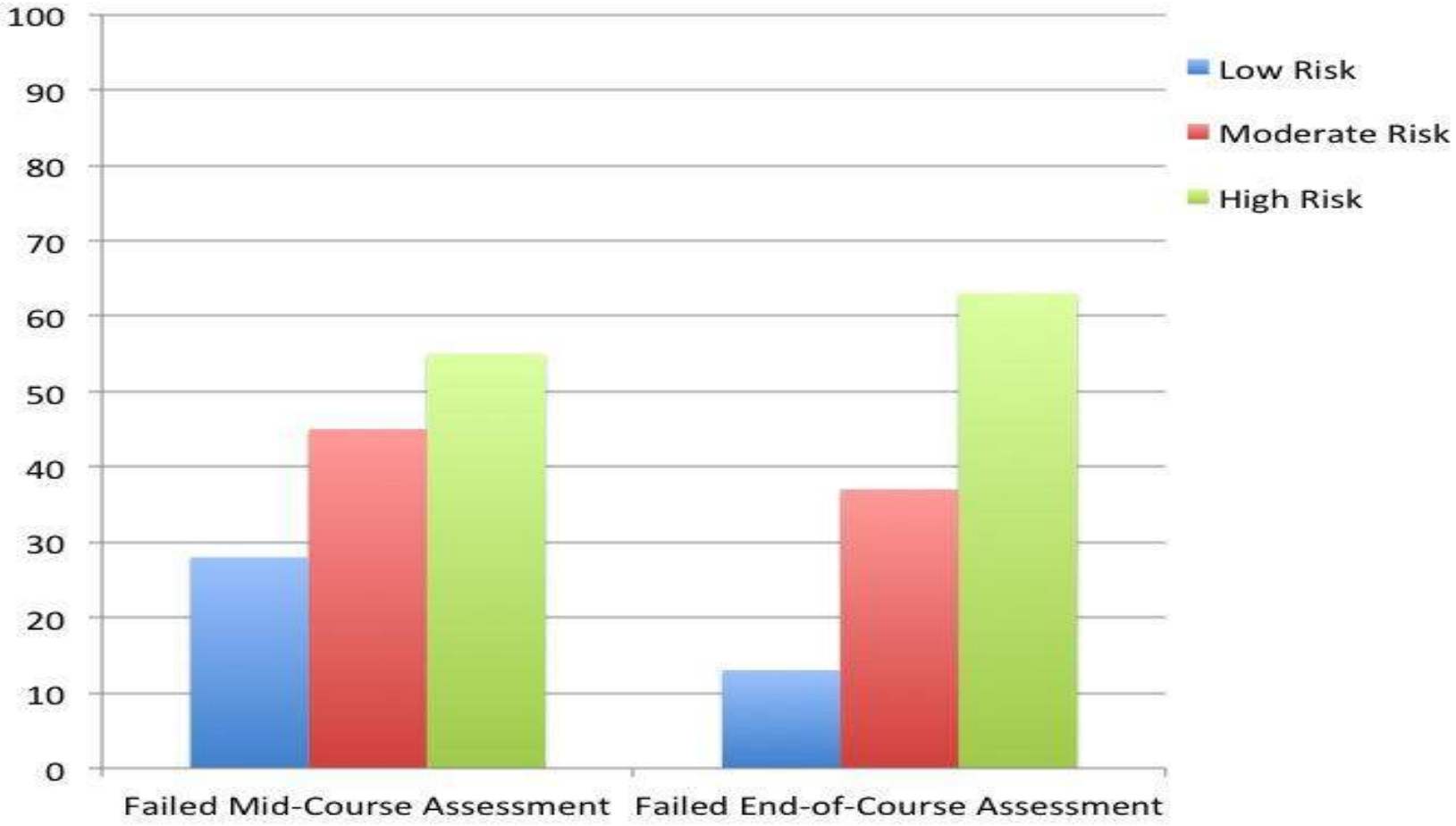
Students believe the course has value.

Students have skills, habits and know-how to succeed in college setting.

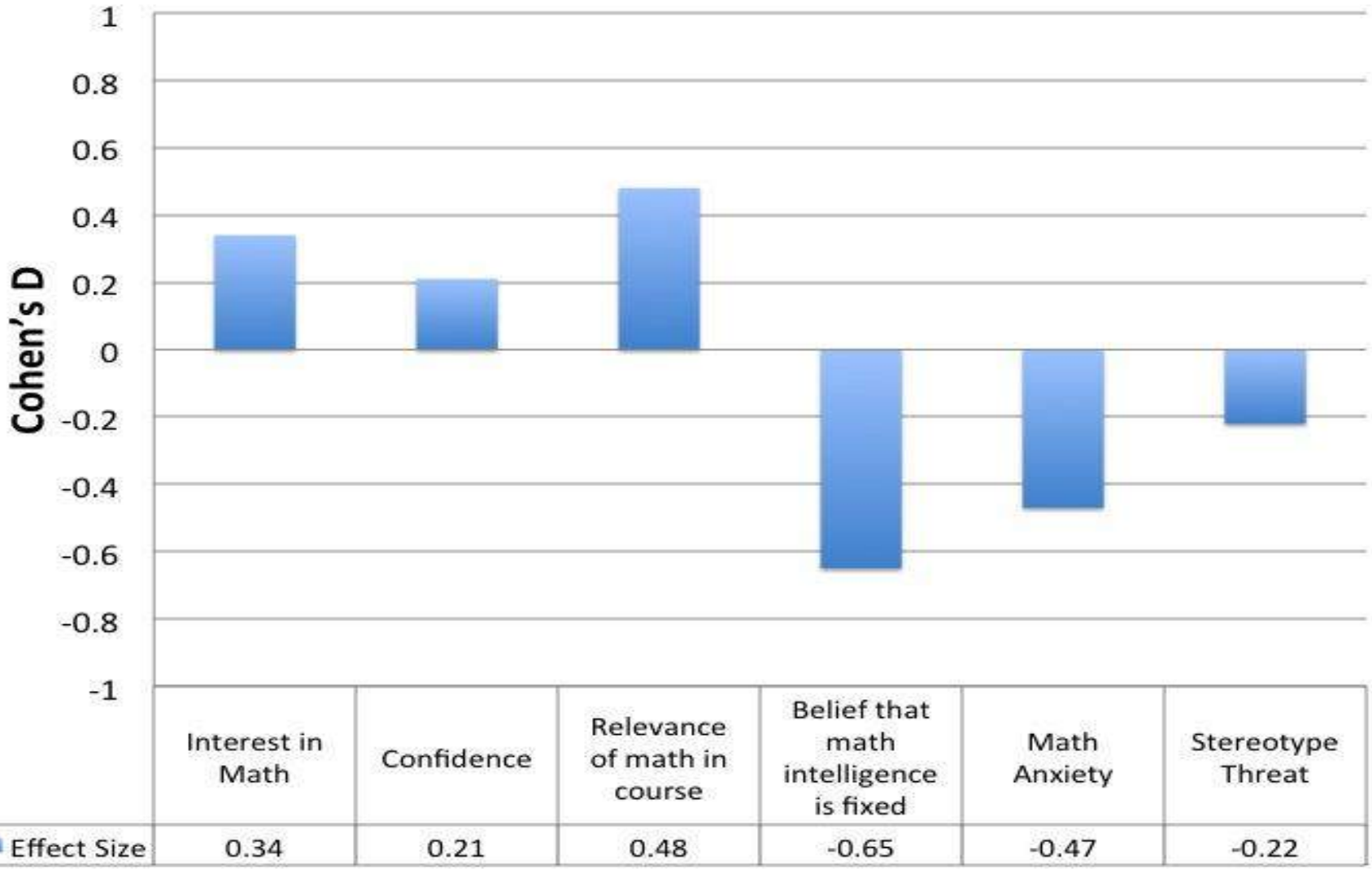
Faculty and college support students' skills and mindsets.

Do students' mindsets matter?

- Based on survey with developmental math students.
- Categorized students as "at risk" or not in terms of the four drivers during week 1



Can we change students' mindsets in the first 4 weeks of class?



	Interest in Math	Confidence	Relevance of math in course	Belief that math intelligence is fixed	Math Anxiety	Stereotype Threat
Effect Size	0.34	0.21	0.48	-0.65	-0.47	-0.22

3. How can student success outcomes be sustained and improved?

Provide sustained, meaningful opportunities for learning from and about practice

Effective faculty professional development for instructional improvement

- Sustained
- Flexible and responsive
- Designed for collaboration
- Grounded in real teaching
- Job-embedded
- Theory related to practice

Goals of Advancing Quality Teaching

System of support for Pathways faculty that:

- Provides a set of learning experiences that improve the quality of instruction reliably and at scale.
- Optimizes the quality of the preparation given faculty time limitations and the absence of financial incentives.
- Meets the needs of the various faculty subgroups (SW/QW, new/existing colleges, full-time/adjuncts).
- Employs technologies that support collaboration and development of community across distance

3. How can student success outcomes be sustained and improved?

Provide sustained, meaningful opportunities for learning from and about practice.

Organizational/Institutional coordination to support effective and sustained implementation.

Key Questions to Examine

1. What is the vision for implementing pathways?
   a. Solve a course success challenge?
   b. Solve a degree completion challenge?
2. Who is the target student population?
3. Who are the relevant stakeholders at your institution?
4. Who are the key leaders to include?
5. What are the potential barriers to implementation?

Pathways Institutional Systems Map

*What are the **POLICIES** that support or hinder Pathways implementation?*

*What is the Institutional **AIM**?*

*What is the **TARGET STUDENT POPULATION**?*

*Who are the **EXTERNAL STAKEHOLDERS?***

*Who are the **INTERNAL STAKEHOLDERS** that need to be involved?*

*What are the **PROCESSES** (sequences of actions) that enable the institution to achieve its aim?*

*What are the **MEASURES OF SUCCESS**?*

*What are the **EXTERNAL RESOURCES** required for implementation?*

What are the **CRITICAL SUCCESS FACTORS** (things the institution must get right for success)?

What are the potential **BARRIERS TO IMPLEMENTATION?**

Creating Your Aim Statement

By spring 2018, 50% of developmental math students are enrolled in Statway (35 sections per term), and they achieve a 60% success rate.

By _____, _____% of developmental math students are enrolled in _____ (_____ sections per term), and they achieve a _____% success rate.

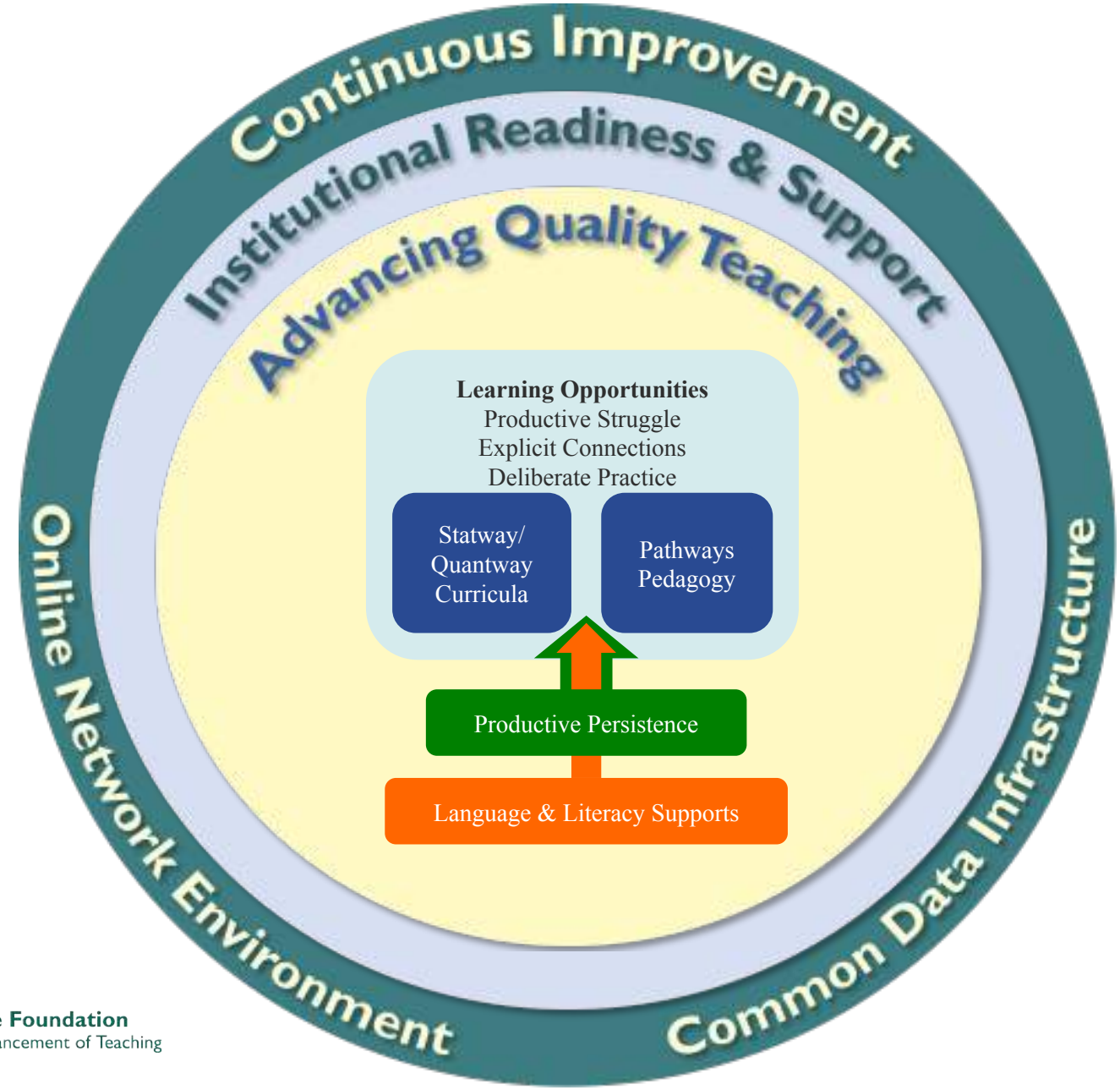
3. How can student success outcomes be sustained and improved?

Provide sustained, meaningful opportunities for learning from and about practice

Organizational/Institutional coordination to support effective and sustained implementation.

Ongoing collaboration to accelerate and spread learning (across the network)

Pathways Networked Improvement Community



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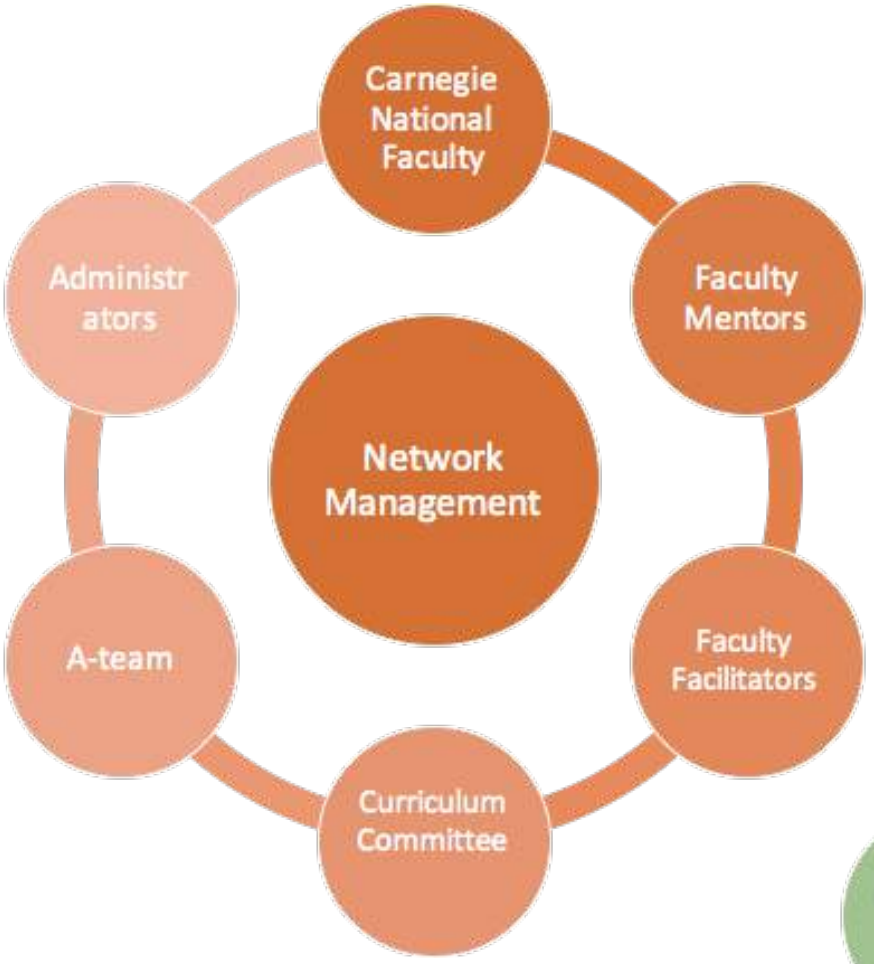
Faculty Network Engagement



Ongoing collaboration to accelerate and spread learning and improvement

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Radical transformation requires

will for collective action

seeing the system

mobilizing across the system to take action across the system

CARNEGIE MATH
PATHWAYS

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