Critical Issues in Mathematics Education 2015:
Developmental Mathematics: For Whom? Toward What Ends?

Scaling Innovation in Higher Education

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DEVELOPMENTAL MATHEMATICS: FOR WHOM?

TABLE 1

Student probability of remedial course placement, by type of college and student background.

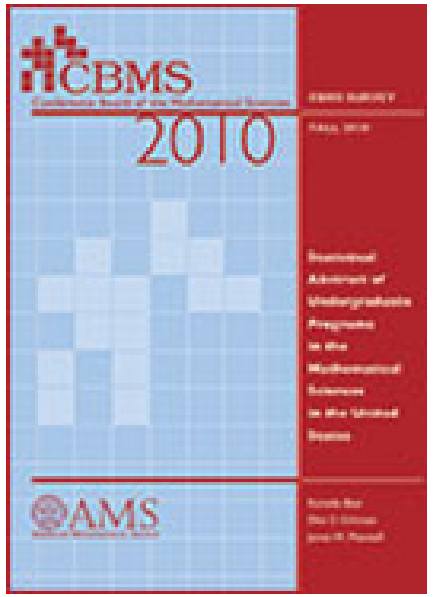
	Bivariate	Logistic regression	Propensity matched
Treatment: Level of entry			
Logistic Coefficient	1.367***	0.529***	0.425***
Predicted probabilities for:			
Two-year college entrants	0.5824	0.3826	0.5236
Four-year college entrants	0.2622	0.2675	0.4181
	N = 6724	N = 6724	N = 3246
Treatment: Public or private college (Four-year entrants only)			
Logistic Coefficient	0.545***	0.516***	0.353***
Predicted probabilities for:			
Public college entrants	0.2940	0.1965	0.2468
Private college entrants	0.1945	0.1273	0.1871
	N = 4154	N = 4154	N = 2456
Treatment: Student race (Black vs. White)			
Logistic Coefficient	1.082***	0.697***	0.443***
Predicted probabilities for:			
White students	0.3493	0.2696	0.4731
Black students	0.6129	0.4257	0.5831
	N = 5490	N = 5490	N = 606
Treatment: Student family SES (split at median)			
Logistic Coefficient	–0.762***	–0.159	0.088
Predicted probabilities for:			
High SES students	0.3167	0.2894	0.4250
Low SES students	0.4982	0.3232	0.4037
	N = 6879	N = 6879	N = 1852

SOURCE: NELS:88

"58% of NELS:88 students at two-year colleges undertook remedial coursework, compared to 26% of students entering four-year colleges. That difference is statistically highly significant."

(Attewell, Lavin, Domina, & Levey, 2006)

Conference Board of Mathematical Sciences (CBMS) Survey Reports 2010



Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States

by Richelle Blair, Ellen E. Kirkman, and James W. Maxwell

Publication Date: 2013

Number of Pages: 374 pp.

Publisher: AMS

ISBN 978-0-8218-9412-5 (Print)

CBMSSURVEY/2010(Print)

Higher Education Mathematics Course Enrollment

	4 Year Institutions				2 Year Institutions			
	1995	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
College Algebra and below	57%	58%	56%	54%	81%	81%	81%	80%
Calculus	37%	35%	37%	38%	10%	8%	7%	7%
Advanced Courses	7%	6%	7%	8%				
Other Courses (2 Year)					12%	10%	12%	12%
TOTAL Enrollment (in thousands)	1469	1614	1607	1971	1348	1273	1580	1887

Source: Adapted from the CBMS 2010 Census Report, Table S.2

DEVELOPMENTAL MATHEMATICS: TO WHAT ENDS?

TABLE 2

Effect of enrolling in one or more remedial course on student progress through higher education.

	Bivariate	Logistic regression	Propensity matched
Outcome: Student earned 10 or fewer credits			
Logistic Coefficient	0.456***	–0.634***	–0.593***
Predicted probabilities for:			
Remedial students	0.1120	0.0183	0.0838
Nonremedial students	0.0740	0.0339	0.1420
	N = 6879	N = 6879	N = 3292
Outcome: Student left college for at least one year before receiving first degree			
Logistic Coefficient	0.666***	–0.101	–0.096
Predicted probabilities for:			
Remedial students	0.4248	0.2535	0.3948
Nonremedial students	0.2751	0.2732	0.4179
	N = 6879	N = 6879	N = 3292
Outcome: Student earned a college degree (two-year college entrants only)			
Logistic Coefficient	–0.328***	0.105	0.179
Predicted probabilities for:			
Remedial students	0.2842	0.2882	0.3404
Nonremedial students	0.3553	0.2672	0.3105
	N = 2661	N = 2661	N = 1670
Outcome: Student earned a college degree (four-year college entrants only)			
Logistic Coefficient	–1.159***	–0.316***	–0.288***
Predicted probabilities for:			
Remedial students	0.5211	0.7367	0.5685
Nonremedial students	0.7761	0.7933	0.6373
	N = 4173	N = 4173	N = 1623
Outcome: Years to Bachelor's degree			
OLS Coefficient	0.633***	0.150***	0.211***
Predicted time to degree for:			
Remedial students	5.070	5.100	4.970
Nonremedial students	4.437	4.950	4.759
	N = 3413	N = 3413	N = 1226

SOURCE: NELS:88

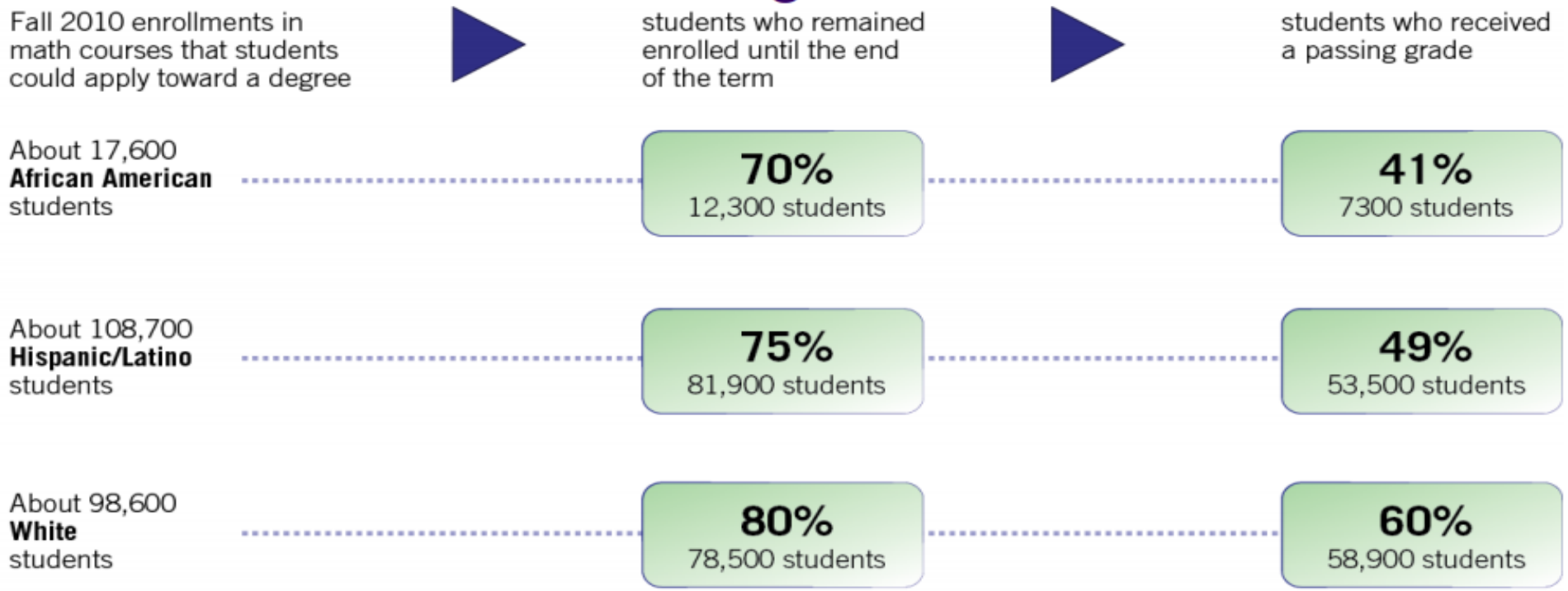
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

"58% of recent high school graduates who entered community colleges took at least one developmental course. Only about one quarter of these students (28%) went on to earn any degree or certificate within 8.5 years"

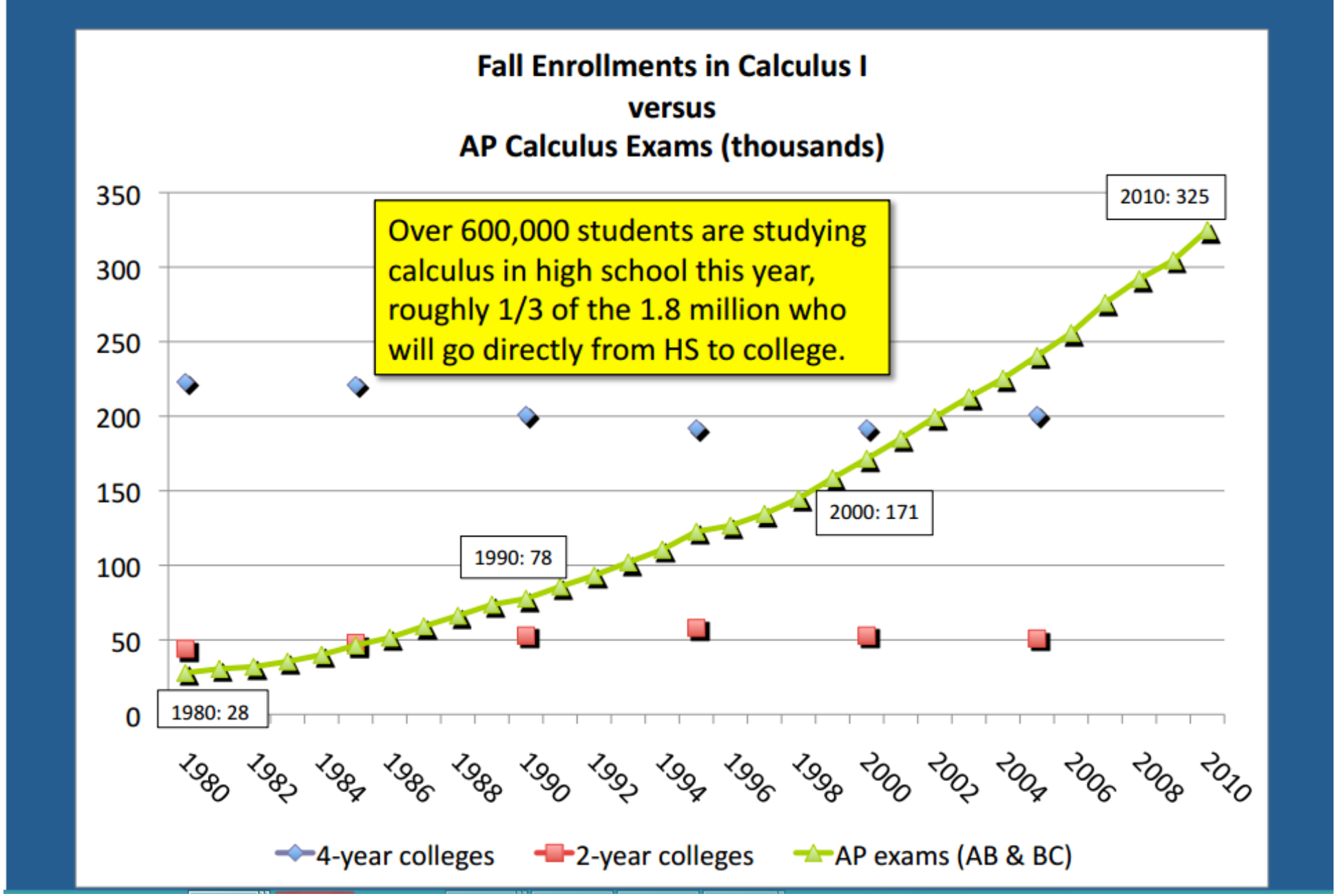
—Community College FAQs, CCRC

High Rates of Failure in Gateway Courses

Students Passing a Math Course that Counts Toward an Associate's Degree



source: *Passing when it counts.* EdSource Issue Brief, February 2012
www.edsource.org/pub12-passing-when-it-counts.html

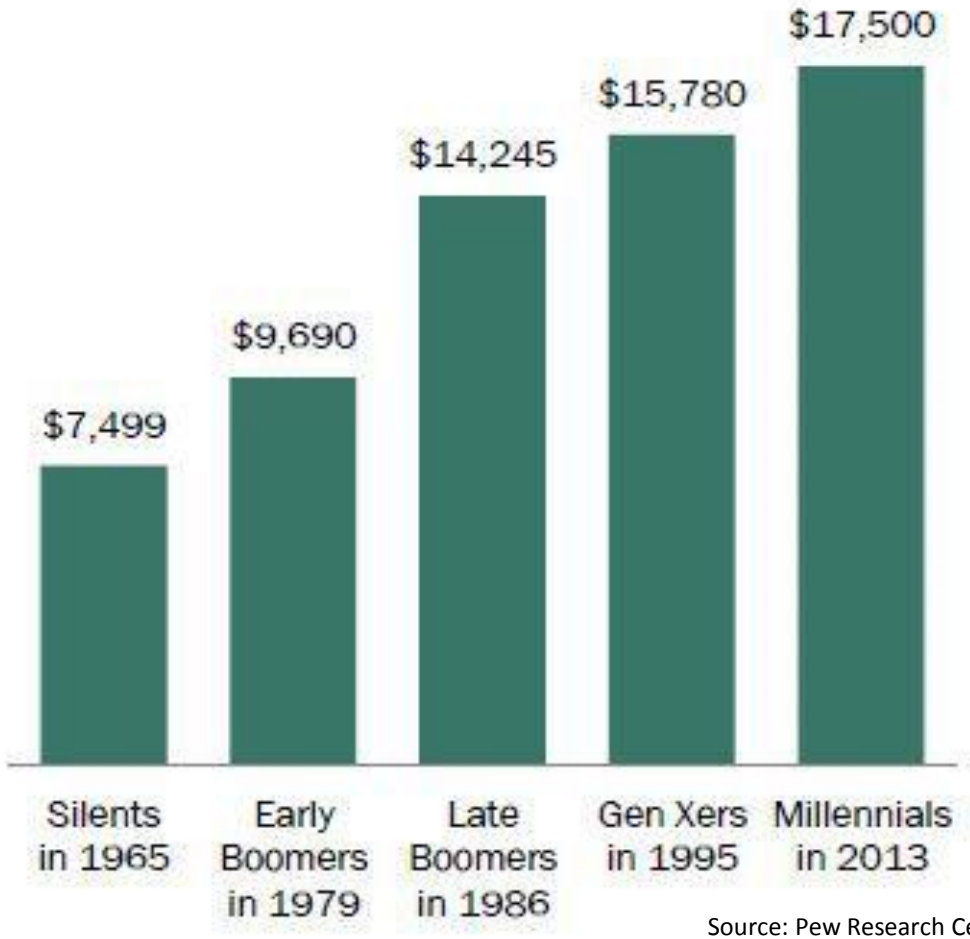


Source: David Bressoud - http://www.macalester.edu/~bressoud/talks/2011/portland-apcalc.pdf

Keep in mind:

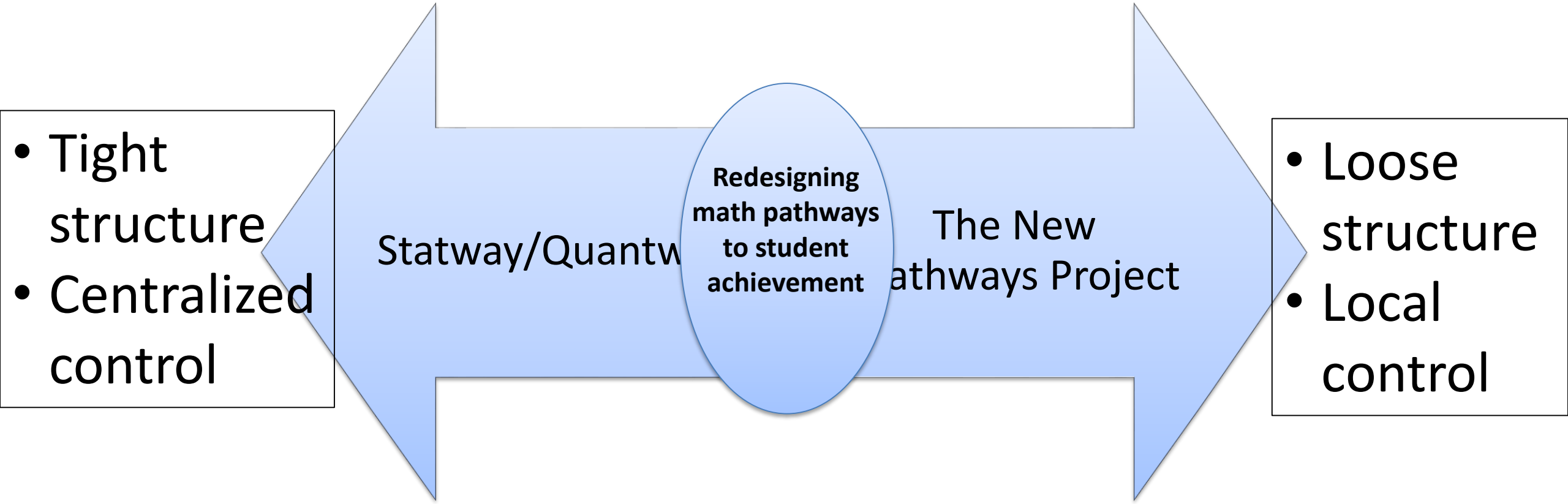
The Widening Earnings Gap of Young Adults by Educational Attainment

The difference in median annual earnings of college and high school graduates when members of each generation were ages 25 to 32

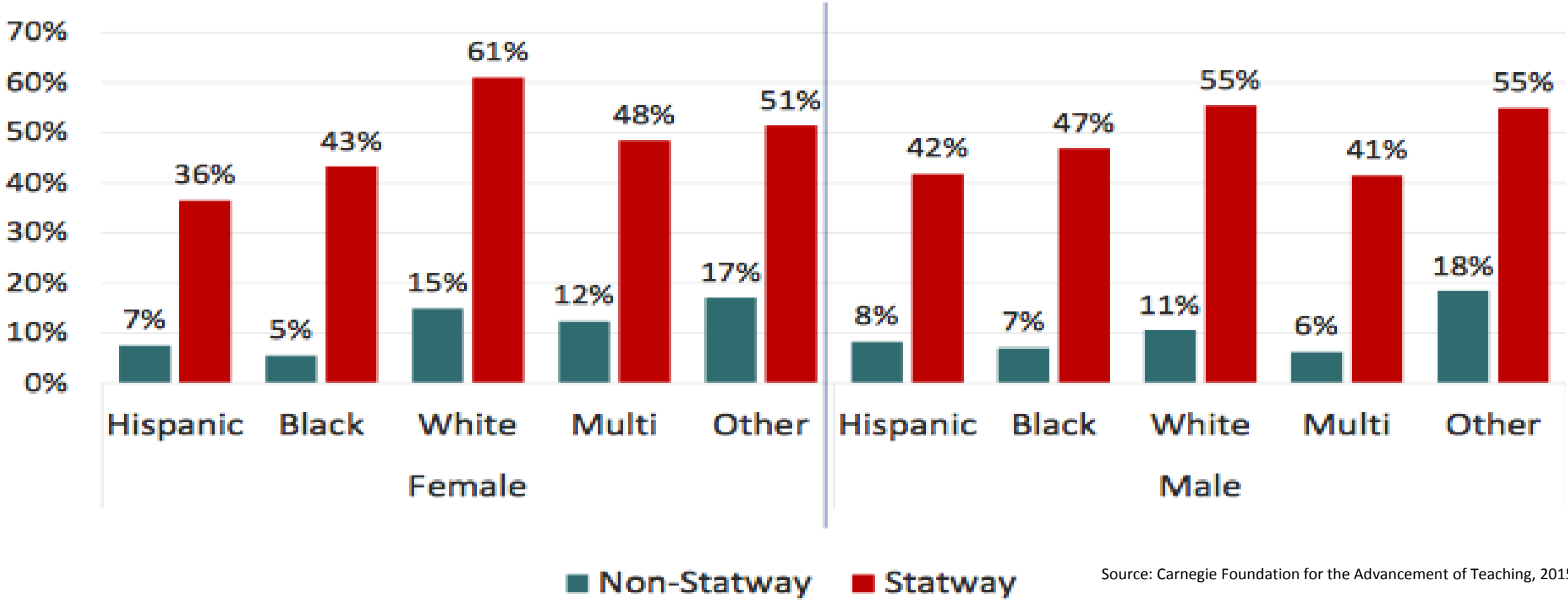


Source: Pew Research Center

WRESTLING WITH INNOVATION


• Tight structure
• Centralized control
Statway/Quantw
Redesigning math pathways to student achievement
The New athways Project
• Loose structure
• Local control

College Math Success by Subgroup



Source: Carnegie Foundation for the Advancement of Teaching, 2015

Reflections on Innovation at Scale

- Innovation as ornamentation
- Working in the fog of collective amnesia
- Myth of the sufficiency of highly effective practices
  - The proper role of data: Is data king?
  - What are the catalysts to turning effective practices into increased levels of student achievement?
- Rhetoric scales faster than practice

Articulation

Content

Sequence Structure

Delivery

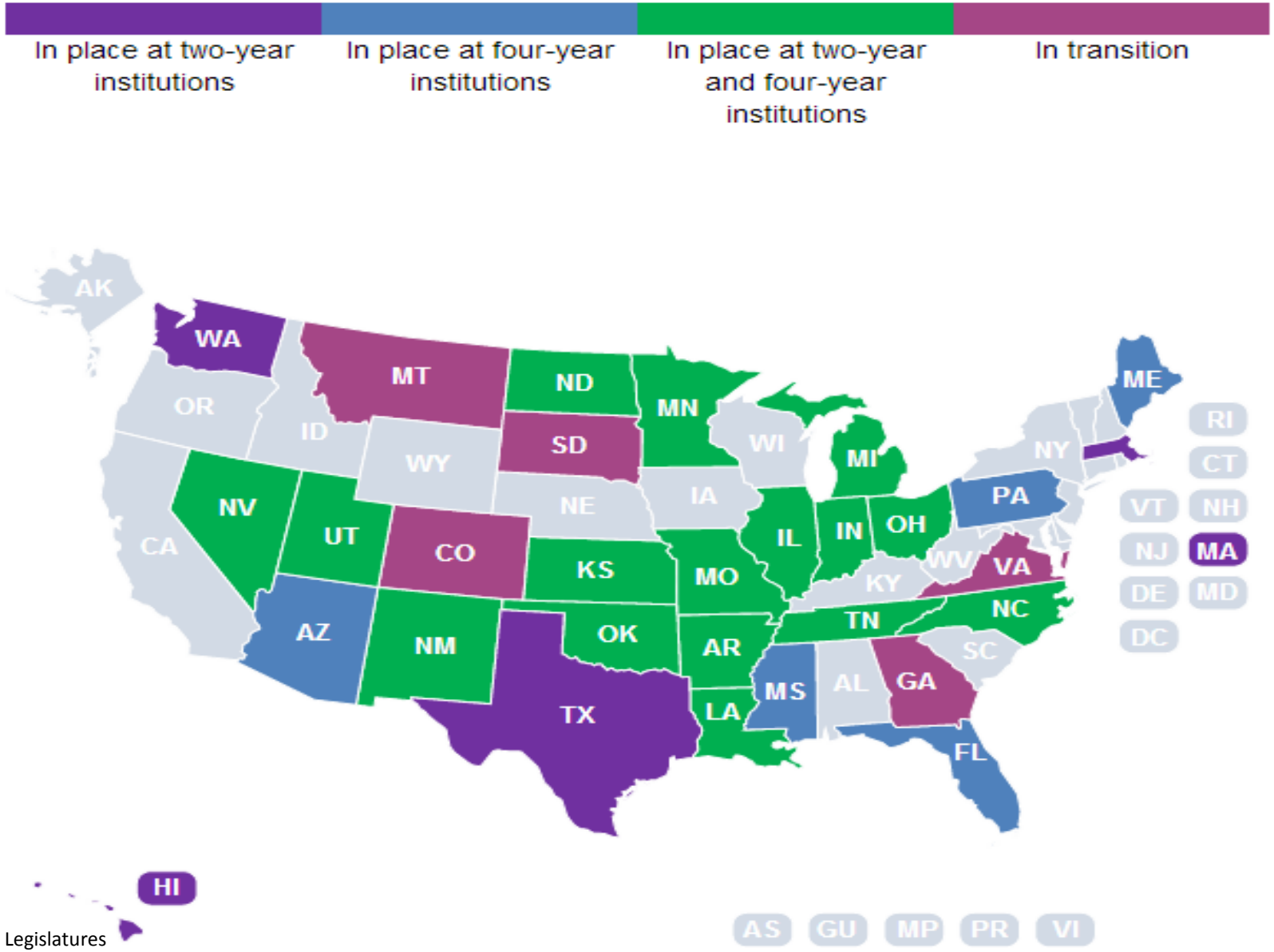
Student Supports

Faculty Supports

Placement

National and State	•Financial aid •Governance
System	•Transfer •Applicability •Articulation
Institutional	•Content •Sequence structure •Student supports •Faculty supports •Advising
Classroom	•Delivery •Technology •…

Performance Based Funding for Higher Education



Source: National Conference of State Legislatures

Principles of the NMP Model

Developmental mathematics students should have access to:

1. Multiple pathways aligned to specific fields of study
2. Acceleration that allows students to complete a college-level math course in one year
3. Intentional use of strategies to help students develop skills as learners directly linked to their courses
4. Curriculum design and pedagogy based on proven practice coupled with a context sensitive improvement strategy

Three Pathways To-and-Through College Transferable Courses

The New Mathways Project

STATISTICS PATHWAY is designed for students seeking a college-level statistics course as part of their general education requirement for majors in fields including:

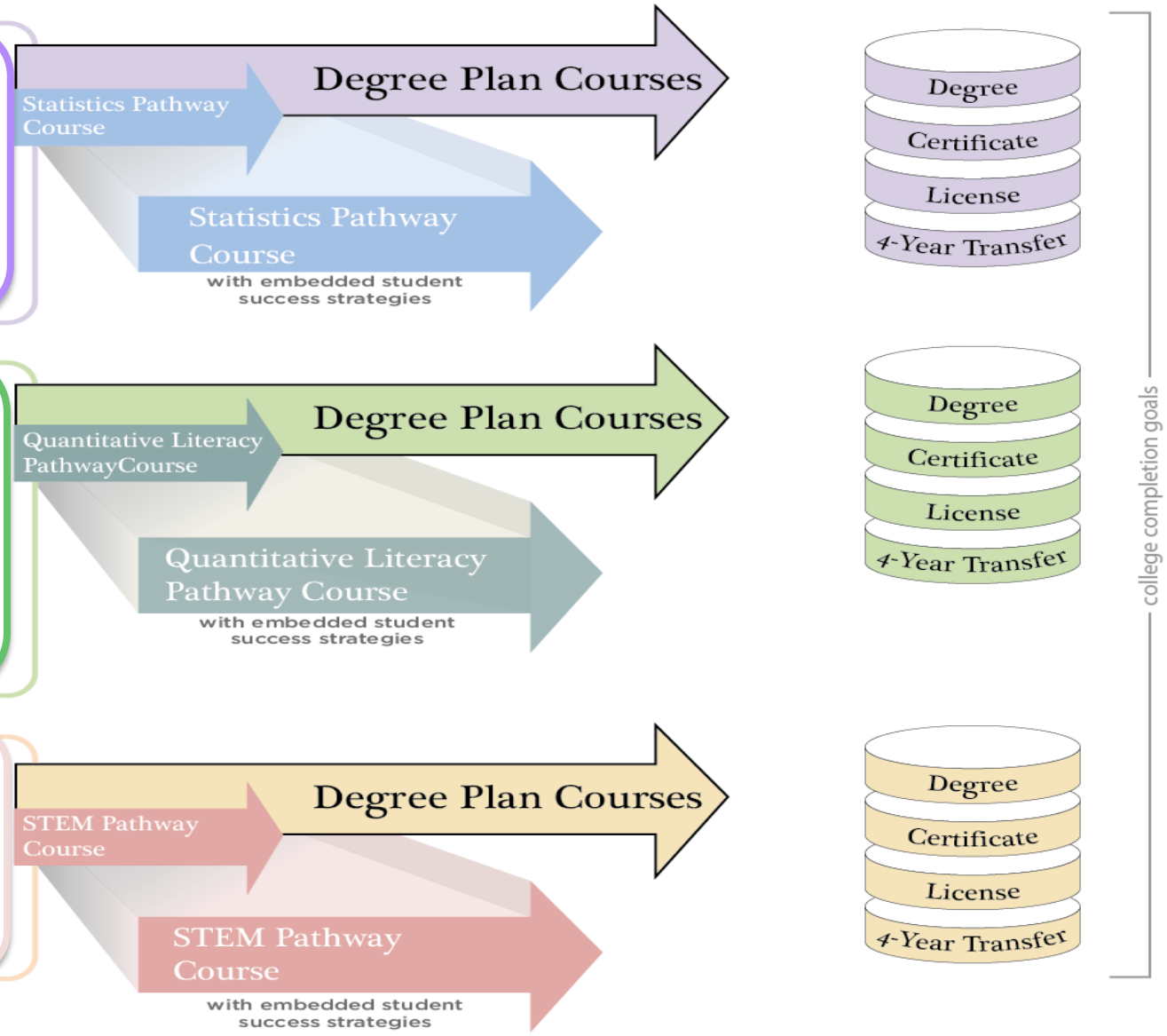
- Nursing
- Social Work
- Criminal Justice

QUANTITATIVE REASONING PATHWAY is designed for students pursuing a field of study in which general education math is a requirement. These fields include majors in:

- Communications
- Graphic Design
- Paralegal

STEM-PREP PATHWAY is designed for students seeking a STEM or mathematics-intensive major in fields including:

- Petroleum Engineering
- Computer Science
- Chemistry



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Critical Components of Scaling Innovation

- ❑ Legitimation
- ❑ Big ‘P’ and little ‘p’ policy changes
- ❑ Coordinated mobilization
- ❑ State math task forces

The key to scaling innovation in higher education: Legitimation

The **coordination of efforts** by mathematicians (the professional math associations, TPSE Math, Common Vision 2025) and leaders of the associations of higher education.

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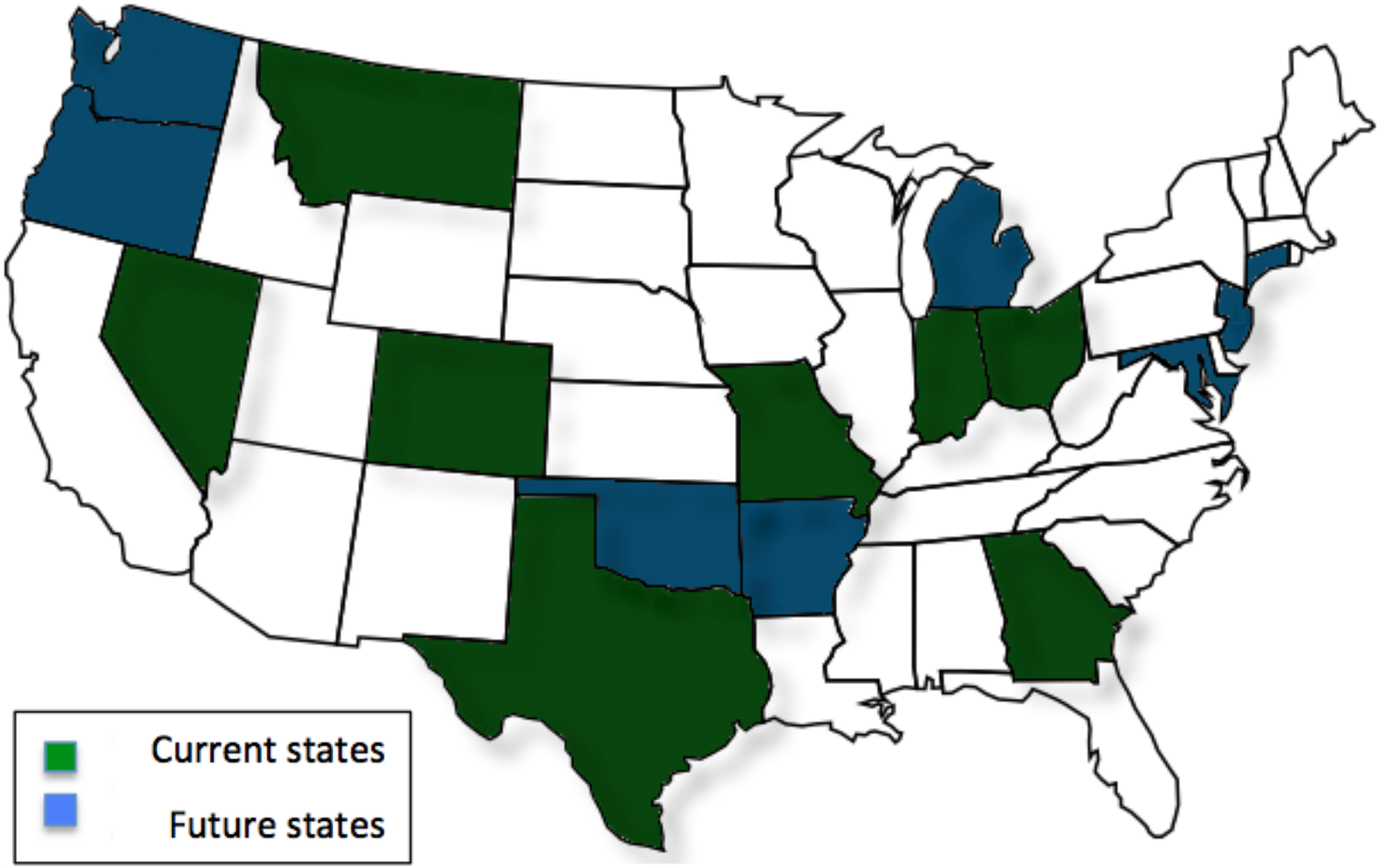

The Dana Center is currently working with eight states:

- Colorado
- Georgia
- Indiana
- Missouri
- Montana
- Nevada
- Ohio
- Texas

Demand for participating in the NMP State Math Task Force project is high. States seeking to join the network include: **Arkansas, Connecticut, Maryland, Michigan, New Jersey, Oklahoma, Oregon, and Washington**.

The University System of Georgia Mathematics Task Force

"…charged with determining how the System's colleges could dramatically improve success rates in gateway mathematics courses without compromising the disciplinary integrity of these courses."

—From *University System of Georgia: Transforming College Mathematics*

Recommendations from the University System of Georgia Mathematics Task Force

1. Focus on supporting success in college credit-bearing, gateway mathematics courses for *all* students.
2. Aligning gateway mathematics course sequences with academic programs of study. In particular, College Algebra should not be the default class for non- STEM majors.
3. Implement a co-requisite approach to support student success in gateway mathematics courses.
4. Develop year-long mathematics pathways for students with significant gaps in preparation.
5. Use multiple measures to place students in gateway courses and appropriate supports.
6. Terminate use of COMPASS as an exit examination.
7. Align the outcomes of gateway mathematics courses with the Common Core Georgia Performance Standards (CCGPS) for Mathematics.
8. Develop advising systems and protocols for placing students in gateway mathematics courses and co-requisite supports that align with their intended programs of study.

Ohio Board of Regents' Charge to the Mathematics Steering Committee

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To develop expectations and processes that result in each campus offering pathways in mathematics that yield
(1) increased success for students in the study of mathematics;
(2) a higher percentage of students completing degree programs; and
(3) effective transferability of credits for students moving from one institution to another.

Recommendations from the Ohio State Math Task Force

1. Improve student success in entry-level courses by aligning mathematics to academic programs of study and by improving instructional delivery mechanisms
2. Develop, implement, and evaluate co-requisite strategies to support underprepared students
3. Redesign OTM course criteria and processes to focus on student learning outcomes
4. Establish a statewide network of mathematics chairpersons
5. Improve communication among mathematics faculty and stakeholders across institutions
6. Develop quality measures for improving student success in mathematics; then collect, analyze, and share relevant data
7. Strengthen collaboration and communication between K12 and higher education on mathematics curriculum and instruction

UNDERGRADUATE MATHEMATICS: THE FUTURE

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1. Math can become the discipline best at curricular modernization and relevance, which requires working with peer disciplines.

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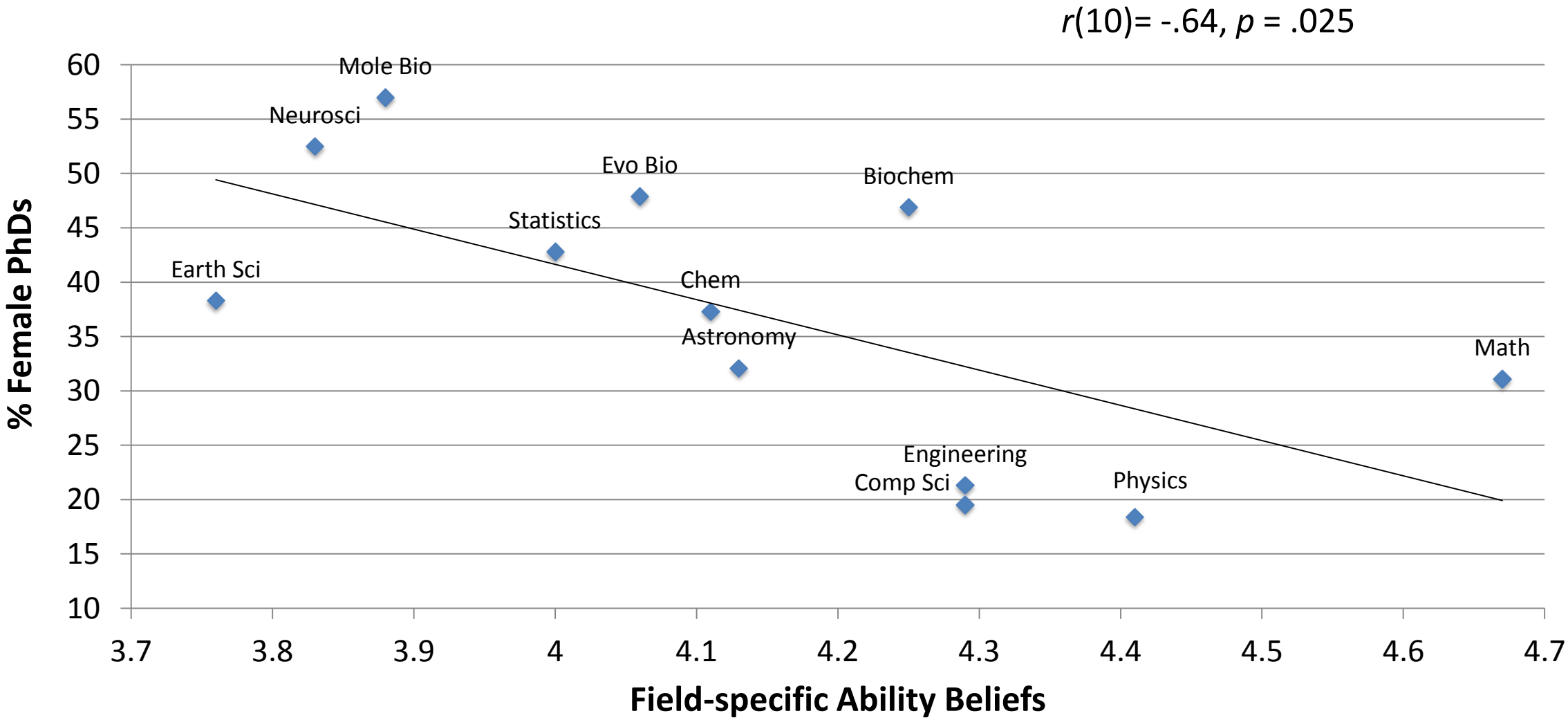
The Correlational Study: STEM



Leslie, Cimpian, & Meyer, in prep.

DEVELOPMENTAL MATHEMATICS: THE REAL GOALS OF REFORM

The Real Goals of Reform

- Make mathematics a vehicle for upward social mobility, not a burial ground for students' aspirations.
- Narrow the gap between mathematics as it is used and what students learn in their courses.
- Improve learning infrastructure to help us get better at providing students with high quality mathematics education.