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Using Multiple Measures of Mathematics Readiness Improves Student Success at Middlesex Community College

This summary is part of the Charles A. Dana Center's "Notes from the Field" series, which highlights examples of innovative practices from colleges, universities, and systems.

Since the 1980s, the use of standardized tests by postsecondary institutions to assess student readiness for college-level mathematics and placement of students in developmental education has grown in popularity. In 2010, 100 percent of two-year institutions and 85 percent of four-year institutions reported using some form of mathematics test for placement.[1] Nationally, an estimated 60 percent of incoming two-year college students place into at least one developmental mathematics course each year, yet only 20 percent complete a college-level mathematics course. [2]

In recent years, researchers and mathematics faculty have questioned the

TAKEAWAYS

- *Implementing multiple measures for mathematics placement, co-requisite support, and mathematics pathways allows students to accelerate their progress to-and-through college-level mathematics for their programs of study.*
- *Using high school grade point average (GPA) as a measure of mathematics readiness is a good predictor of college readiness and success.*
- *Appropriate mathematics placement can eliminate forcing students into long developmental mathematics sequences.*
- *Accelerating student completion of college-level mathematics courses increases demand for upper-level mathematics courses, such as Calculus II.*

use of standardized tests as a sole predictor of college readiness. Often, test scores underestimate student potential to succeed in college-level courses and disproportionately place students of color, low-income students, and returning adults into prerequisite developmental courses. A growing body of rigorous studies finds that giving students direct access to college-level courses with co-requisite support significantly increases the likelihood that students across a broad range of test scores will complete a college mathematics course. Research also demonstrates that using multiple measures of readiness, including high school GPA, increases student access and success in college-level courses.[3] In light of these findings, Middlesex Community College implemented and scaled a placement policy using multiple measures of mathematics readiness with positive results that demonstrate its impact on improving student success in college-level mathematics courses.

Background

Middlesex Community College (MCC) has two campuses in Massachusetts that serve over 12,000 students annually with more than 70 available degree and certificate programs. MCC's student population includes 46 percent first-generation students, 25 percent minority students (e.g., Hispanic/Latino, African American), and 42 percent Pell grant-receiving students. Operating in a centralized higher education system, MCC exercises institutional autonomy in its strategic planning initiatives to support student success; the college works to align many of its initiatives and student success approaches with state-level efforts.

In March 2012, the Massachusetts Department of Higher Education (DHE) formed the Task Force on Transforming Developmental Math Education to develop recommendations to systemically improve the percentage of students who complete developmental mathematics and pass their first college-level mathematics course requirement. The final report from the task force recommended a three-pronged strategic approach—including multiple measures of placement, co-requisite remediation, and alignment of mathematics pathways to programs of study—to reduce remediation and improve student success.[4] Since 2013, extensive efforts on state and institutional levels propelled Massachusetts' higher education institutions to take action. Examples include:

- Implementing and scaling of new placement criteria using high school GPA.
- Implementing co-requisite support models for students to enroll directly into college-level courses with appropriate support.
- Ensuring students take the right mathematics courses for their majors, increasing alignment of mathematics courses to promote on-time completion, and increasing transferability and applicability of mathematics courses.

Strategic technical assistance from both Complete College America and the Charles A. Dana Center at The University of Texas at Austin have supported the implementation and scale efforts for Massachusetts' three-pronged approach.[5] For more information, refer to the Mathematics Pathways to Completion–Massachusetts resource site page.[6]

Challenges

Mathematics faculty at MCC analyzed data, which showed that students placed in long developmental sequences as a result of standardized testing (e.g., the Accuplacer) were far less likely to graduate or even complete their first college-level mathematics course. "The Accuplacer is not as accurate as we would like it to be. I think all schools feel that way," said Linda Dart-Kathios, mathematics department chairperson. "Students are often placed below their abilities because they don't prepare for the Accuplacer or don't take it very seriously, resulting in them being improperly placed into a developmental math course they don't need."

MCC believed it could do a better job for students attending community college, who may have selected this route because it was a less expensive way to begin their postsecondary education. "We needed to have mathematics

pathways and alternative placement options for our students," said Dr. Kate Sweeney, dean of health and science, technology, engineering, and mathematics. As a result, an alternative mathematics placement method using high school GPA was introduced, giving the college a better way to properly place students on a more direct path to complete their gateway mathematics courses.

Solutions

GPA Pilot Study. As part of the statewide, three-pronged approach to reduce remediation and improve student success, the DHE and the Massachusetts Board of Higher Education approved revisions to the 1998 common assessment policy by authorizing new criteria for placement in developmental education and college-level courses. In academic year 2014–15, Middlesex Community College, along with many other two- and four-year institutions across Massachusetts, participated in a campus GPA pilot study to test revised placement standards of college readiness for recent high school graduates. The two placement standards in the pilot study included:

- **Pilot A Standard**: Weighted high school GPA of 2.7 or above with optional additional measures, including high school mathematics GPA and/or SAT scores.
- **Pilot B Standard**: Weighted high school GPA between 2.4–2.69 with optional additional measures, including high school mathematics GPA and/or SAT scores.

MCC's initial pilot study, which involved 121 students, had promising results. Students placed into college-level mathematics courses based on a high school GPA of 2.7 or higher had similar completion rates as their peers.[7] The study also showed that students with a high school GPA of 2.4–2.69 did not perform as well as students placed with a GPA of 2.7 or higher, or as well as their college-ready peers. Table 1 highlights Fall 2014 pilot study results.

Table 1

Middlesex Community College: Fall 2014 Campus GPA Pilot Results

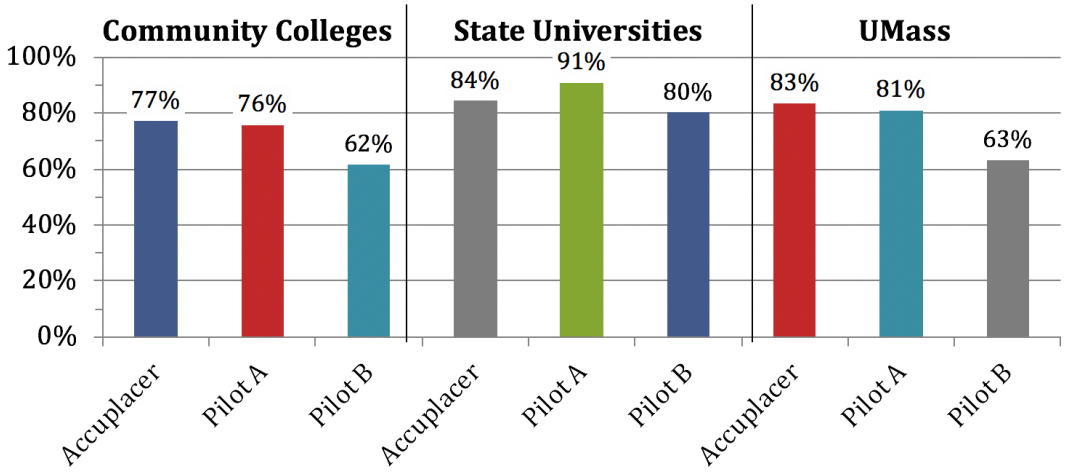
Students in Fall 2014 pilot	121
Students placed in college-level math using placement standards	85
Students in comparison group	36
Placement	
• DEVMTH-A with a high school GPA of 2.7 or above	73
• DEVMTH-B with a high school GPA between 2.4 and 2.69	12
Completion Rate	
• DEVMTH-A cohort	**76.7%**
• Comparison group (in course sections with cohort)	**73.3%**
• DEVMTH-B cohort	**50%**

Note: Adapted from "Middlesex GPA Pilot Placement" by Dart-Kathios & Sweeney (2016).[8]

An external qualitative study of the campus pilot GPA study was published in October 2015.[9] Statewide, preliminary course completion results mirrored the promising results from MCC (see Figure 1[10]). This led the DHE to extend its support for pilot studies using high school GPA as a measure for placement through the academic year 2018-19.

Figure 1

% Completing College-Level Math in 2014-15 by "College-Ready" Status



Although Middlesex Community College expanded its multiple measures of mathematics placement, the institution elected not to continue its pilot efforts for the Pilot B Standard in Fall 2015. For the next two years, mathematics course completion rates for MCC students who were placed using multiple measures (e.g., the Accuplacer, the Pilot A Standard) held steady across multiple gateway mathematics courses.

Table 2 highlights Fall 2015 and Fall 2016 GPA placement course completion rates, which indicate that those students placed using multiple measures (cohort study group) continued to do as well as, if not better than, those students who went through the developmental mathematics sequence (comparison group) at MCC.

Table 2

Middlesex Community College: Fall 2015 and Fall 2016 Gateway Mathematics Course Completion Rates for Cohort Study Group and Comparison Group

	Fall 2015		Fall 2016	
	Cohort Study Group	**Comparison Group**	**Cohort Study Group**	**Comparison Group**
Total Overall Student Enrollment	**181**	**1,291**	**192**	**1,164**
MAT 100: Intermediate Algebra	82%	68%	--	--
MAT 120: Math for Liberal Arts	77%	76%	93%	72%
MAT 130: Elements of Mathematics	80%	78%	83%	67%
MAT 165: Trigonometry	67%	64%	--	--
MAT 177: Statistics	77%	74%	78%	72%
MAT 182: Precalculus for Business & Social Science	67%	73%	78%	77%
MAT 195: Precalculus for Engineering & Social Science	63%	69%	54%	68%
MAT 196: Accelerated Precalculus & Trigonometry for Engineering & Science	0%	95%	50%	80%
MAT 290: Calculus I	0%	46%	100%	68%
MAT 291: Calculus II	--	--	100%	68%
Overall Completion Rate	**74.59%**	**72.81%**	**78.1%**	**72.0%**

Note: Completion rates include all students placed into college-level and developmental MAT coursework. Fall 2015 data are adapted from Dart-Kathios & Sweeney (2016).[11]

In MCC's 2014 pilot study, students whose GPA was high enough to place them directly into college-level mathematics courses were hesitant to enroll in such courses because they lacked confidence in their skills. However, the pilot study reinforced the institution's belief that high school GPA is a good predictor of college readiness and success and that proper placement can eliminate forcing students, who do not need them, into long developmental mathematics sequences.

Co-Requisites and Alignment of Mathematics Pathways. Along with making placement changes, MCC has been transforming developmental mathematics education with co-requisite support courses that help underprepared students complete their gateway mathematics course in one year or less.[12] To help students not eligible for the mathematics placement GPA criteria of 2.7 or higher enter directly into college-level mathematics courses, the mathematics department offers two acceleration approaches.

Linda Dart-Kathios (left) and Dr. Kathleen (Kate) Sweeney (right).

The first approach allows students to complete their developmental coursework while concurrently enrolled in a college-level math course, also known as a co-requisite support course. The college offers co-requisite support courses for both Statistics and Math for Liberal Arts, the terminal courses that a majority of students need to complete the math requirement for their programs of study. In Fall 2019, a co-requisite support course for Precalculus for Engineering and Social Science (MAT 195) will be piloted.

The second approach offers accelerated, eight-week "mini-mester" courses for students to complete their developmental coursework in the first-half of the semester and then enroll in Statistics or Math for Liberal Arts in the second-half of the semester. This approach gives students the opportunity to complete their developmental mathematics coursework and college-level mathematics course consecutively in one semester.

In addition to using multiple measures of mathematics placement and co-requisite support, MCC is creating program-specific pathways aligned with the statewide MassTransfer Pathways initiative. MassTransfer Pathways builds on the state's common course numbering initiative to ease the process of transfer among public colleges and universities governed by the MassTransfer policy.[13] For MCC, this current work includes engaging faculty from partner disciplines in the MassTransfer process and identifying the appropriate default mathematics course(s) for a given program of study. Future work includes revising institutional structures, policies, and processes to reflect the alignment of mathematics courses agreed upon during the MassTransfer process.

Dr. Sweeney said the use of multiple measures of mathematics placement aligns well with the implementation of co-requisite courses, and the alignment of mathematics pathways gives the college more effective ways of placing students in the appropriate mathematics course(s) for their areas of study.

Additional Findings

Between Fall 2013 and Fall 2018, MCC's actions to implement and scale Massachusetts' strategic three-pronged approach to developmental mathematics reform significantly impacted enrollment across the institution's mathematics program:

- The number of students enrolled in developmental mathematics courses decreased by 35 percent.
- The number of students enrolled in Calculus and above more than doubled.
- The number of students enrolled in courses post-College Algebra increased from 14 percent to 23 percent.
- The number of students enrolled in the Quantitative Reasoning pathway more than tripled.

Table 3 highlights this shift in student enrollment.

Table 3

Student Enrollment Shifts in Mathematics Department from Fall 2013 to Fall 2018

	Fall 2013	Spring 2014	Fall 2017	Spring 2018	Fall 2018
Developmental Math Enrollment	74%	67%	47%	45%	41%
First College-Level Math Enrollment	26%	32%	53%	55%	59%
Enrollment in Calculus and above	3%	4%	7%	9%	8%
Enrollment in Math for Liberal Arts	11%	14%	32%	30%	36%
Enrollment in Algebraic Pathway*	14%	18%	21%	25%	23%

*College-level courses that require College Algebra as a prerequisite (e.g., MAT 182, MAT 195); not including College Algebra enrollment

"Since we are getting students to a higher level of math more efficiently, they are actually taking more levels of math with us before they transfer (to a four-year institution)," said Dart-Kathios. "Our demand for upper-level classes has grown."

Endnotes

[1] https://www.nagb.gov/content/nagb/assets/documents/commission/researchandresources/test-and-cut-scores-used-for-student-placement-in-postsecondary-education-fall-2011.pdf

[2] Bailey, T., Jeong, D. W., & Cho, S. (2009). Referral, enrollment, and completion in developmental education sequences in community colleges. *Economics of Education Review, 29*(2), 255–270.

[3] http://ccrc.tc.columbia.edu/publications/predicting-success-placement-tests- transcripts.html

[4] http://www.mass.edu/bhe/lib/documents/AAC/AAC14-12DevelopmentalMathEducationTaskForceRecommendations-supersededbyOct22ndAACmeetingedit.pdf

[5] https://completecollege.org/massachusetts/

[6] http://dcmathpathways.org/where-we-work/massachusetts

[7] Students in the comparison group were college-ready students who took college-level mathematics courses after completing developmental mathematics prerequisites at MCC.

[8] http://www.mass.edu/strategic/comp_developmath.asp

[9] http://www.mass.edu/bhe/lib/documents/AAC/10_AAC%2016-19%20Developmental%20Math%20Pilots%20and%20Qualitative%20Study.pdf

[10] http://www.mass.edu/strategic/comp_developmath.asp

[11] http://www.mass.edu/strategic/comp_developmath.asp

[12] http://dcmathpathways.org/sites/default/files/resources/2018-01/Designing%20Math%20Pathways%20Report_FINAL_0.pdf

[13] http://www.mass.edu/strategic/comp_transferpathways.asp

Contact Information

For more information about Middlesex Community College's multiple measures of mathematics placement, co-requisite support, or alignment of mathematics courses to programs of study, please contact:

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About the Dana Center

The Charles A. Dana Center develops and scales mathematics and science education innovations to support educators, administrators, and policy makers in creating seamless transitions throughout the K–16 system for all students, especially those who have historically been underserved. We focus in particular on strategies for improving student engagement, motivation, persistence, and achievement.

The Center was founded in 1991 at The University of Texas at Austin. Our staff members have expertise in leadership, literacy, research, program evaluation, mathematics and science education, policy and systemic reform, and services to high-need populations.

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