Developmental Mathematics Education Pilot

Report on Quantitative Analyses for FY 2017

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UMASS DONAHUE INSTITUTE
Applied Research & Program Evaluation

Developmental Mathematics Education Pilot

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Executive Summary

On behalf of the Massachusetts Department of Higher Education (DHE), the University of Massachusetts Donahue Institute (UMDI) Applied Research and Program Evaluation (ARPE) group conducted an evaluation of developmental education strategies in mathematics that are being implemented at selected Massachusetts community colleges and state universities. Several policies for placing students in developmental and gateway college-level mathematics courses are being tested, and the primary purpose of this evaluation was to assess the effectiveness of these policies for (1) increasing the number and proportion of students participating in and passing one or more credit bearing mathematics course within their first two years of enrollment, and (2) shrinking the gap in the rate of enrollment among African American and Latino students.

This report addresses the following research questions[1]:

> *RQ1a*: Did new assessment policies have impact on the placement of students in developmental education courses?
>
> *RQ1b*: Did implementation of BHE's new assessment policies have impact on students' successful completion of their first college-level mathematics course?[2]

This is the second of two planned reports addressing these research questions with quantitative analyses. This report includes data from students who enrolled in one baseline (pre-pilot) year (FY 2014) and the third year (FY 2017) in which pilots were active. The previous quantitative report addressed comparisons between students' performance for those who enrolled in (FY 2014) compared to FY 2015 and FY 2016.

<u>Key finding</u>: Students who entered college in fall 2016 (during the pilot) were no more or less likely than similar students who entered college in fall 2013 (prior to pilot) to take or complete a college-level math course within two years.

- ✓ Students determined to be college math ready by pilot (in fall 2016) were no more or less likely than similar students determined to be college math ready by ACCUPLACER (in fall 2013) to take or complete a college-level mathematics course within two years.
- ✓ Students determined to be college math ready by pilot (in fall 2016) were more likely than similar students determined to be college math ready by ACCUPLACER (in fall 2013) to take a developmental mathematics course within two years of enrollment.

[1] DHE and ARPE agreed that research question RQ1c was adequately addressed in the first quantitative report and would not be addressed in the current report.

[2] This question is a modified version of RQ1b presented in past reports. The question was modified for this report because DHE and ARPE agreed that this final report would only include a specific subset of analyses presented in the first quantitative report prepared as part of this work.

- ✓ Community College students determined to be college math ready by pilot (in fall 2016) were less likely than similar students determined to be college math ready by ACCUPLACER (in fall 2013) to complete a college-level mathematics course within two years.
- ✓ Hispanic students who entered college in fall 2016 (during the pilot) were no more or less likely than similar students who entered college in fall 2013 (prior to pilot) to take or complete a college-level mathematics course within two years; however, Hispanic students determined to be college math ready by pilot (in fall 2016) were less likely than similar students determined to be college math ready by ACCUPLACER (in fall 2013) to complete a college-level mathematics course within two years.

Introduction

Postsecondary education opportunities have increased in recent decades to both positive and negative effects. Increased community college enrollment and growth in online instruction has fostered opportunities for degree-seekers. However, educators have realized that many recent high school graduates in the U.S. are not fully prepared for college coursework and find themselves taking non-credit bearing developmental courses.[3] National data collected during the last decade suggest that approximately one-third of first-year degree seekers were enrolled in one or more developmental courses. Estimates are as high as 40 percent for community college students.[4] In addition, race and economic status are disproportionately associated with developmental course enrollment. Between 2010 and 2014, 30 percent of degree-seeking white students were enrolled in a developmental course. During the same time period, 57 percent of African American students and 56 percent of Latino students were enrolled in a developmental course. In addition, 39 percent of students from economically disadvantaged backgrounds were enrolled in developmental courses.

Given these problems with student preparedness and readiness for college-level courses, a common standard for the state of Massachusetts was initiated in 1998 after education administrators noted placement inconsistencies across public higher education institutions. At the time, institutions maintained autonomy with regard to the type of placement test and cut-off scores used for determination. Varying institutional adherence to policy led, for example, to some students being placed in developmental courses at one institution but not others.

In order to minimize inconsistencies across Massachusetts community colleges and four-year public universities, the Policy on Common Assessment was enacted by the Massachusetts Board of Higher Education (BHE) in 1998. As a consequence, the Accuplacer, which is a compilation of tests in mathematics, reading, and writing became the gold standard for determination and placement. Despite the use of the Accuplacer, inconsistencies remained prevalent among Massachusetts community colleges. A 2013 BHE study found that placement decisions by these institutions were incongruent with the Policy on Common Assessment. For example, assessment officials used cut-off scores that were incongruent with state policy, test retakes were allowed as were the use of calculators.

A revised BHE policy implemented in FY 2015 took into account these inconsistencies, as well as research that indicated that GPA is just as relevant as placement scores for determining student

[3] Schak, O., Metzger, I., Bass, J., McConn, C., & English, J. (2017).Developmental Education: Challenges and Strategies for Reform

[4] Ibid.

success.[5] This revised policy—and its impact on student outcomes—is the primary focus of this evaluation.

The Developmental Math Pilot Program has completed four years of a pilot phase of experimentation and innovation (FY 2015, FY 2016, FY 2017, and FY 2018), and campuses were offered the option to continue or revise their pilot implementation in fall 2016 (during FY 2017). The three pilot implementation standards active during FY 2017 are defined in Table 1 below.

Table 1. Pilot Standard Definitions

Pilot Standard	Definition
A1	Student determined to be college ready based on a high school GPA of 2.7 or above.
A2	Student determined to be college ready based on a high school GPA of 2.7 and a "B" or higher in Algebra II.
A3	Student determined to be college ready based on a high school GPA of 2.7 and four years of high school math.

This report addresses the following research questions[6]:

> *RQ1a*: Did new assessment policies have impact on the placement of students in developmental education courses?
>
> *RQ1b*: Did implementation of BHE's new assessment policies have impact on students' successful completion of their first college-level mathematics course?[7]

This is the second of two planned reports addressing these research questions with quantitative analyses. This report includes data from students who enrolled in one baseline (pre-pilot) year (FY 2014) and the third year (FY 2017) in which pilots were active. The previous quantitative report addressed comparisons between students' performance for those who enrolled in (FY 2014) compared to FY 2015 and FY 2016.

[5] Massachusetts Board of Higher Education, Task force on Transforming Developmental Math Education. (2013). *Final Report From the Task Force on Transforming Developmental Math Education.*

[6] DHE and ARPE agreed that research question RQ1c would not be addressed in the current report.

[7] This question is a modified version of RQ1b presented in past reports. The question was modified for this report because DHE and ARPE agreed that this would only include a specific subset of analyses presented in the first quantitative report prepared as part of this work.

Results

This section presents findings from statistical analyses that compared rates of participation in developmental mathematics, enrollment in at least one credit mathematics course, and completion of at least one credit mathematics course during the pilot (FY 2017) to rates just prior to pilot (FY 2014). Only institutions implementing a pilot standard during FY 2017 were included in these analyses. We compared students who enrolled for the first time at one of these institutions during the pilot period (FY 2017) to students who enrolled for the first time at one of these institutions during the baseline period (FY 2014). Findings comparing students who were determined to be college math ready using a pilot standard (during FY 2017) to similar students from the baseline period (FY 2014) are also presented.

We used rigorous, quasi-experimental, matched comparison group designs to draw strong conclusions about the impact of the pilots (Cook and Campbell 1979).[8] Technical descriptions of the statistical methods are presented in Appendix A.

Compared with students who enrolled in a pilot campus one year prior to pilot, students who enrolled at a pilot campus during the pilot (FY 2017) were no more or less likely to enroll in a developmental or gateway college-level mathematics course within two years of enrollment. Compared with students who enrolled in a pilot campus one year prior to pilot, students who enrolled at a pilot campus during the pilot (FY 2017) were also no more or less likely to complete a gateway college-level mathematics course within two years of enrollment.

Compared with students who were enrolled in a pilot campus and determined to be college math ready one year prior to pilot (FY 2014), students determined to be college math ready by pilot (in FY 2017) were more likely to enroll in developmental mathematics within two years of enrollment. However, pilot participants were no more or less likely to enroll in or complete gateway college-level mathematics course within two years of enrollment.

Impacts of policy implantation that were statistically significant are summarized in Table 2 through Table 7 below. Each table notes two levels of significance, or “p-values.” Lower p-values correspond to a higher degree of confidence that a result represents a true difference between groups rather than random variation in the data.

[8] Treatment and comparison groups were matched on gender, race/ethnicity, low-income status, English language learner status, disability status, grade level, rate of school attendance, and pre-intervention test performance.

The tables provide odds ratios, indicating the degree of impact of the math placement pilot.[9] An odds ratio greater than one indicates that the outcome was more likely after pilot began than before the pilot began, while an odds ratio less than one indicate that the outcome was less likely after pilot began than before the pilot began. For example, an odds ratio of 1.3 for developmental math taking means that students who enrolled at piloting campuses for the first time in FY 2017 were 1.3 times as likely as students who enrolled at piloting campuses for the first time in FY 2014 to enroll in one or more developmental mathematics courses within two years of their initial enrollment. An odds ratio of 0.7 for Credit math completing means that students who enrolled at piloting campuses for the first time in FY 2017 were 0.7 times as likely as students who enrolled at piloting campuses for the first time in FY 2014 to complete one or more college-level mathematics courses within two years of their initial enrollment.

The tables also provide a 99 percent confidence interval (CI), recognizing that the sample of students in the study might be somewhat different from the full population from which they were drawn (all piloting public colleges and universities in the Commonwealth of Massachusetts). The confidence interval provides a range that has a 99 percent chance of including the true value of the odds ratio for that population.

Tables 2–4 show results of analyses that compared students who enrolled for the first time at one of these institutions during the pilot period (FY 2017) to students who enrolled for the first time at one of these institutions during the baseline period (FY 2014).

[9] Researchers seeking effect sizes can calculate them directly from the reported odds ratios by subtracting one (1). Effect sizes for MCAS results were calculated separately and are reported in relevant tables and appendices.

Table 2 shows that students at piloting institutions were no more or less likely to enroll in a developmental mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot). Additional summary statistics, by institution, are included in Appendix B (Excel Workbook).

Table 2. Developmental Math Taking – FY 2014 (baseline) vs. FY 2017 (pilot) – All Students at Piloting Institutions

Student Group	Treatment % Taking	Comparison % Taking	Odds Ratio	99% CI
All	41%	47%	Not Significant	-
Community College Students	47%	54%	Not Significant	-
State University Students		Insufficient Sample		
Men	42%	45%	Not Significant	-
Women	41%	49%	Not Significant	-
African American		Insufficient Sample		
Asian		Insufficient Sample		
Hispanic	43%	51%	Not Significant	-
White	35%	45%	Not Significant	-

*$p < .01$, **$p < .001$. *Note:* Only statistically significant results are presented. An odds ratio greater than one indicates that the outcome was more likely after the pilot began.

Table 3 shows that students were no more or less likely to enroll in a college-level mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot). Additional summary statistics, by institution, are included in Appendix B (Excel Workbook).

Table 3. Credit Math Taking – FY 2014 (baseline) vs. FY 2017 (pilot) – All Students at Piloting Institutions

Student Group	Treatment % Taking	Comparison % Taking	Odds Ratio	99% CI
All	49%	51%	Not Significant	-
Community College Students	42%	44%	Not Significant	-
State University Students		Insufficient Sample		
Men	50%	52%	Not Significant	-
Women	48%	50%	Not Significant	-
African American		Insufficient Sample		
Asian		Insufficient Sample		
Hispanic	34%	37%	Not Significant	-
White	54%	53%	Not Significant	-

*$p < .01$, **$p < .001$. *Note:* Only statistically significant results are presented. An odds ratio greater than one indicates that the outcome was more likely after the pilot began.

Table 4 shows that students were no more or less likely to complete a college-level mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot). Additional summary statistics, by institution, are included in Appendix B (Excel Workbook). Additional summary statistics, by institution, are included in Appendix B (Excel Workbook).

Table 4. Credit Math Passing – FY 2014 (baseline) vs. FY 2017 (pilot) – All Students at Piloting Institutions

Student Group	Treatment % Passing	Comparison % Passing	Odds Ratio	99% CI
All	40%	42%	Not Significant	-
Community College Students	32%	35%	Not Significant	-
State University Students		Insufficient Sample		
Men	40%	42%	Not Significant	-
Women	40%	43%	Not Significant	-
African American		Insufficient Sample		
Asian		Insufficient Sample		
Hispanic	26%	29%	Not Significant	-
White	45%	45%	Not Significant	-

*$p < .01$, **$p < .001$. *Note:* Only statistically significant results are presented. An odds ratio greater than one indicates that the outcome was more likely after the pilot began; an odds ratio less than one indicates that the outcome was less likely after the pilot began.

Tables 5–7 provide results of analyses that compared students who were determined to be college math ready using a pilot standard (during FY 2017) to students determined to be college math ready using ACCUPLACER during the baseline period (FY 2014). It is understood that there were likely differences between these populations that could not be accounted for by propensity score weighting procedures. For example, it is understood that a larger portion of students determined to be college math ready during the baseline period took a credit bearing mathematics course as a first math course than students determined to be college math ready by pilot. The results presented in tables 4–6 reflect these differences, and should be interpreted with caution.

Table 5 shows that college math-ready students were more likely to enroll in a developmental mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot). This was true for all college math ready students, all pilot students, community college students, men, women, Hispanic, and white students.

Table 5. Developmental Math Taking – FY 2014 (baseline) vs. FY 2017 (pilot) – College Math-Ready Students Only

Student Group	Treatment %	Comparison %	Odds Ratio	99% CI
All College Math Ready	12%	2%	6.13**	[1.92, 19.46]
All Pilot Students	18%	2%	11.67**	[2.30, 59.18]
Pilot A1 Participants	22%	2%	21.84**	[3.18, 149.94]
Pilot A2 Participants	Insufficient Sample			
Pilot A3 Participants	Insufficient Sample			
Community College Students	24%	2%	9.76**	[4.48, 21.27]
State University Students	Insufficient Sample			
Men	17%	2%	16.89**	[3.73, 76.55]
Women	19%	2%	10.33**	[1.92, 55.68]
African American	Insufficient Sample			
Asian	Insufficient Sample			
Hispanic	20%	4%	5.69**	[1.60, 20.22]
White	16%	2%	11.41**	[1.94, 67.26]

*$p < .01$, **$p < .001$. *Note:* Only statistically significant results are presented. An odds ratio greater than one indicates that the outcome was more likely after the pilot began.

Table 6 shows that college math-ready students were no more or less likely to enroll in a credit mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot).

Table 6. Credit Math Taking – FY 2014 (baseline) vs. FY 2017 (pilot) – College Math-Ready Students Only

Student Group	Treatment %	Comparison %	Odds Ratio	99% CI
All College Math Ready	77%	84%	Not Significant	-
All Pilot Students	75%	84%	Not Significant	-
Pilot A1 Participants	72%	83%	Not Significant	-
Pilot A2 Participants		Insufficient Sample		
Pilot A3 Participants		Insufficient Sample		
Community College Students	66%	81%	Not Significant	-
State University Students		Insufficient Sample		
Men	74%	86%	Not Significant	-
Women	75%	83%	Not Significant	-
African American		Insufficient Sample		
Asian		Insufficient Sample		
Hispanic	64%	82%	Not Significant	-
White	76%	85%	Not Significant	-

*$p < .01$, **$p < .001$. *Note:* Only statistically significant results are presented.

Table 7 shows that college math-ready students were no more or less likely to complete a credit mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot). Community college students and Hispanic students who were college math ready were less likely to complete a credit mathematics course—within two years of initial enrollment—in FY 2017 (during the pilot) than they were in FY 2013 (prior to pilot).

Table 7. Credit Math Passing – FY 2014 (baseline) vs. FY 2017 (pilot) – College Math-Ready Students Only

Student Group	Treatment %	Comparison %	Odds Ratio	99% CI
All College Math Ready	65%	73%	Not Significant	-
All Pilot Students	64%	73%	Not Significant	-
Pilot A1 Participants	62%	71%	Not Significant	-
Pilot A2 Participants		Insufficient Sample		
Pilot A3 Participants		Insufficient Sample		
Community College Students	52%	67%	0.62**	[0.42, 0.90]
State University Students		Insufficient Sample		
Men	61%	72%	Not Significant	-
Women	65%	76%	Not Significant	-
African American		Insufficient Sample		
Asian		Insufficient Sample		
Hispanic	53%	69%	0.62*	[0.40, 0.96]
White	66%	74%	Not Significant	-

*$p < .01$, **$p < .001$. *Note:* Only statistically significant results are presented. An odds ratio less than one indicates that the outcome was less likely after the pilot began.

Table 8 shows that, among students at piloting institutions whose first math course was college-level, the percent of students who *completed* college-level math within two years varied by year and institution. Completion rates ranged from 69% to 93% for the FY 2014 cohort and from 64% to 95% for the FY 2017 cohort. The highest completion rates occurred at Westfield State University, Framingham State University, and Fitchburg State University.

Table 8. Percent of Students who Completed a College-level Math Course Within Two Years, Among Those Whose First Math Course Was College-level

School	FY 2014 % Completing	FY 2017 % Completing
Pilot A1		
Bristol Community College	85%	84%
Bunker Hill Community College	80%	84%
Fitchburg State University	89%	93%
Cape Cod Community College	69%	64%
Massasoit Community College	79%	74%
Middlesex Community College	83%	83%
Westfield State University	93%	95%
Mt. Wachusett Community College	84%	80%
North Shore Community College	77%	71%
Northern Essex Community College	78%	75%
Pilot A2		
Berkshire Community College	82%	77%
Bristol Community College	85%	84%
Holyoke Community College	85%	87%
Pilot A3		
Framingham State University	92%	91%
Salem State University	81%	89%
Quinsigamond Community College	89%	79%

Table 9 shows the rates at which students completed at least one college-level math course within two years, by race and institution type, for all students at all institutions, regardless of pilot status. College-level math completion was higher at 4-year state universities than at community colleges in all subgroups. Among 4-year state university students in FY 2017, white students had the highest completion rates, whereas among community college students in the same year, Asian students had the highest completion rates.

Table 9. Percent of Students Completing at Least One College-level Math Course Within Two Years

	4-Year State Universities		Community Colleges	
	FY 2014	FY 2017	FY 2014	FY 2017
American Indian	86%	42%	19%	19%
Asian	66%	61%	46%	50%
Black	70%	68%	24%	27%
Hispanic	61%	64%	20%	21%
White	72%	75%	32%	35%
Other	69%	68%	28%	36%

Table 10 shows rates of two-year credit math taking and completion by pilot type for the FY 2017 cohort. The sample sizes for participants in each pilot varied widely, with 241 participants in Pilot A2, 1,189 in Pilot A3, and 2,545 in Pilot A1. Credit math completion was highest among Pilot A3 participants, at 67%.

Table 10. Number and Percent of Students Who Took and Completed Credit Math by Pilot Type, FY 2017

	Took credit math within two years				Completed credit math within two years			
	No		Yes		No		Yes	
Student Group	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Pilot A1 Participants	716	28%	1829	72%	964	38%	1581	62%
Pilot A2 Participants	53	22%	188	78%	82	34%	159	66%
Pilot A3 Participants	238	20%	951	80%	392	33%	797	67%

Note on Results

This repot highlights outcomes for students from FY 2017, and our previous quantitative report highlights outcomes for students from FY 2015 and FY 2016. The results presented in these two reports are not comparable. There are three key differences between the analyses presented in these reports:

1. The placement polices being evaluated differed. The current report highlights outcomes for institutions and students participating in pilots in FY 2017 (Pilot A1, Pilot A2, and Pilot A3), while

our prior quantitative report highlights outcomes for institutions and students participating in pilots in FY 2015 and FY 2016 (Pilot A and Pilot B).

2. The samples differed. The analyses presented in this repot primarily compare outcomes for students from FY 2017 to students from FY 2014. The prior quantitative report primarily compared outcomes for students from FY 2015 and FY 2016 to students from FY 2014. Similarly, different institutions piloted placement standards during the two pilot periods, and the samples of participating institutions varied accordingly.
3. The method of analysis differed. At DHE's request, college math readiness was included as a factor in sample selection, weighting, and modeling procedures—when appropriate—for analyses included in the current report. For our previous quantitative report, we did not consider college math readiness as a factor in sample selection, weighting, or modeling procedures.

Differences in results presented in the two quantitative report stem, in part, from these differences.

Appendix A - Methodology

Regression Analyses

Differences in outcomes for students at piloting sites were assessed using a quasi-experimental matched comparison group design. Multi-level mixed-effect logistic regression analyses were conducted to assess the impact of participation on various student outcomes—enrollment in developmental mathematics course, enrollment in a gateway college-level mathematics course, and completion of one or more college-level mathematics courses within two years of enrollment—where students were nested within sites. Carefully selected covariates were included in each analysis to minimize the potential for bias. These covariates included gender, race/ethnicity, full-time status at entry, and college-math-ready status at entry. This design enabled strong inferences about the impact of the Developmental Mathematics Pilot Program on the performance of students who enrolled at a piloting campus in FY 2017 (during the pilot) as compared to the expected level of student performance in the absence of the intervention (i.e., students enrolled at piloting institutions in FY 2013—prior to intervention).

Students were not randomly assigned to the intervention. Each site applied their own criteria to assign students to treatment. Therefore, it is likely that there were pre-intervention differences between participating students and non-participating students. These differences could have represented a significant threat (i.e., selection bias) to the validity of the study's findings. To reduce these differences substantially, propensity score weighting procedures were used, thereby improving the validity of the estimates of program impacts. Factors included in the weighting procedure included: gender, race/ethnicity, full-time status at entry, and college-math-ready status at entry. Notably, college-math-ready status at entry was not included in the weighting procedure completed during the first phase of this study (in which results from FY 2014 were compared to results from FY 2015 and FY 2016). College-math-ready status at entry was added to the weighting procedure in the second phase of the quantitative study because DHE and UMDI agreed upon criteria that could be used to determine the college-math-ready status of students during the pilot period after the first phase of the quantitative study was complete.

In total, 42 models pre-pilot students (first enrolled in FY2014) to post-pilot students (first enrolled in FY 2017) were analyzed. For 28 of the 42 models assessed in this study, propensity score weighting results were within the parameters specified in the U.S. Department of Education's What Works Clearinghouse "Procedures and Standards Handbook" (2014).

Student outcomes were assessed two years after their initial enrollment. For example, if a student enrolled in a developmental math course within their first two years of enrollment, then that student was counted as a developmental mathematics course taker. Similarly, if a student enrolled in and completed one (or more) college-level mathematics courses within two years of enrollment, then that student was counted as having taken and completed a credit mathematics course.

Description of modeling procedures

For all students and for all subgroups of interest, mixed-effects logistic regression models were developed to assess the impact of the intervention. Mixed-effects logistic regression contains both fixed effects and random effects. The following equation represents the general modeling procedure:

$$Y_{ij} = \beta_0 + \beta_1(Participant_{ij}) + \beta_2(Full\text{-}time_{ij}) + \beta_3(Asian_{ij}) + \beta_4(Black_{ij}) + \beta_5(Hispanic_{ij}) + \beta_6(White_{ij}) + \beta_7(Male_{ij}) + \beta_7(Male_{ij}) + \beta_8(College\text{-}math\text{-}ready_{ij}) + u_{0j} + e_{ij}$$

For $i = 1, \ldots, n_j$ students, and $j = 1, \ldots,$ n sites.

Random effects were included to account for site and individual student effects by adding a random error term for each site (u_i), and individual observations (e_{ij}). β_0 represents the intercept. The coefficients β_1 through β_7 represent the fixed effects of a given covariate on the outcome (Y_{ij}).

For this study, the coefficient of greatest interest was β_1, which represents the estimated impact of program participation on students' performance on the outcomes of interest. Outcomes of interest included enrollment in developmental mathematics within two years of initial enrollment, enrollment in a gateway college-level mathematics course within two years of initial enrollment, and completion of a college-level mathematics course within two years of initial enrollment. All outcomes (i.e., values for Y_{ij}) were binary (i.e., course enrollment and completion), so multi-level logistic regression analyses were conducted.

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Figure 3. Percent Placed in Developmental Math & Took a College-Level Math Course within 2 Years

Figure 4. Share of Students Completing at Least a 2nd Math course After Gateway Math, by Gender and Cohort

Figure 5. Share of Students Completing at Least a 2nd Math Course After Gateway Math, by Race & Cohort

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Executive Summary

On behalf of the Massachusetts Department of Higher Education (DHE), the University of Massachusetts Donahue Institute (UMDI) Applied Research and Program Evaluation group is conducting an evaluation of developmental education strategies in mathematics that are being implemented at selected Massachusetts community colleges and state universities. Several policies for placing students in developmental and gateway college-level mathematics courses are being tested, and the primary purpose of this evaluation is to assess the effectiveness of these policies for (1) increasing the number and proportion of students participating in and passing one or more credit bearing mathematics course within their first two years of enrollment, and (2) shrinking the gap in the rate of enrollment among African American and Latino student.

The purpose of this report is three-fold: (1) to assess whether new assessment policies have had an impact on the placement of students in developmental education courses; (2) to determine if placement in particular courses has had an impact on students' successful completion of both developmental courses and their first gateway college-level mathematics course; and (3) to determine students' performance in mathematics courses taken after the completion of their first gateway college-level mathematics course. The research questions addressed this report are listed below, along with a summary of key findings for each question.

This is the first of two planned reports addressing these research topics/questions. This report includes data from one baseline (pre-pilot) year (FY2014) and the first two years) in which pilots were active (FY2015 and FY2016). The next quantitative report will primarily address comparisons between student performance in (FY2014) to student performance in FY2017 and FY2018.

Key outcomes by research question:

> *RQ1a*: Did new assessment policies have impact on the placement of students in developmental education courses?

A complex picture emerged regarding the impact of the Developmental Math Placement pilot. Compared with students who enrolled in a pilot campus one year prior to pilot, students who enrolled at pilot campuses during the period of pilot implementation were more likely to enroll in a gateway college-level mathematics course within two years of enrollment, and were also more likely to complete a gateway college-level mathematics course within two years of enrollment. However, students who enrolled in a pilot campus while the pilot was being implemented were no more or less likely to enroll in a developmental mathematics course (within two years of enrollment) than students who enrolled at a pilot campus prior to the period of pilot implementation.

> *RQ1b*: Did placement of students in particular courses have impact on students' successful completion of both developmental education courses and their first gateway college-level mathematics course?

Overall, a much higher percentage of students whose first mathematics course was at the college level (versus students beginning in developmental mathematics) completed at least one credit mathematics course within two years than students whose first mathematics course was developmental. Across all piloting campuses, 82.9 percent of students whose first mathematics course was at the college level completed college level mathematics course within two years of enrollment, and 21.1 percent of students whose first mathematics course was developmental completed a college level mathematics course within two years—representing a difference of over 61 percentage points. Analyses indicate that across all institutions, the lower in the developmental mathematics sequence that a student is first enrolled, the less likely they are to take (and complete) at least one college-level mathematics course within two years of their initial enrollment.

> *RQ1c*: If students took mathematics courses after the first gateway college-level mathematics course, how did they perform?

Among all students at piloting sites that first enrolled in FY 2014, FY 2015, or FY 2016, and passed a gateway college-level mathematics course, 56.6 percent subsequently *took* at least one additional mathematics course for credit within two years of enrollment. In addition, 41.9 percent of students who first enrolled during the same period and completed their first gateway college-level mathematics course then *completed* at least one additional college-level mathematics course within two years of enrollment.

The percentage of students who completed a gateway college-level mathematics course and at least one additional college-level mathematics course increased slightly from FY 2014 to FY 2016. The percentage of students who completed at least one additional college-level mathematics course after completing a gateway course varied by gender and race. A higher percentage of men (46.4 percent) than women (37.5 percent) completed at least one college-level mathematics course after completing a gateway college-level mathematics course. Asian students had the highest percentage of students completing at least a second mathematics course after gateway mathematics at 51.6 percent, followed by White students at 43.7 percent. Approximately one-third of students who were Hispanic (34.6 percent), African American (34.3 percent), or American Indian or Alaska Native (32.6 percent) completed two or more college-level mathematics courses within two year of enrollment.

Introduction

Postsecondary education opportunities have increased in recent decades to both positive and negative effects. Increased community college enrollment and growth in online instruction has fostered opportunities for degree-seekers. However, educators have realized that many recent high school graduates in the U.S. are not fully prepared for college coursework and find themselves taking non-credit bearing developmental courses.[1] National data collected during the last decade suggest that approximately one-third of first-year degree seekers were enrolled in one or more developmental courses. Estimates are as high as 40 percent for community college students.[2] In addition, race and economic status are disproportionately associated with developmental course enrollment. Between 2010 and 2014, 30 percent of degree-seeking white students were enrolled in a developmental course. During the same time period, 57 percent of African American students and 56 percent of Latino students were enrolled in a developmental course. In addition, 39 percent of students from economically disadvantaged backgrounds were enrolled in developmental courses.

Given these problems with student preparedness and readiness for college-level courses, a common standard for the state of Massachusetts was initiated in 1998 after education administrators noted placement inconsistencies across public higher education institutions. At the time, institutions maintained autonomy with regard to the type of placement test and cut-off scores used for determination. Varying institutional adherence to policy led, for example, to some students being placed in developmental courses at one institution but not others.

In order to minimize inconsistencies across Massachusetts community colleges and four-year public universities, the Policy on Common Assessment was enacted by the Massachusetts Board of Higher Education (BHE) in 1998. As a consequence, the Accuplacer, which is a compilation of tests in mathematics, reading, and writing became the gold standard for determination and placement. Despite the use of the Accuplacer, inconsistencies remained prevalent among Massachusetts community colleges. A 2013 BHE study found that placement decisions by these institutions were incongruent with the Policy on Common Assessment. For example, assessment officials used cut-off scores that were incongruent with state policy, test retakes were allowed as were the use of calculators.

A revised BHE policy implemented in FY 2015 took into account these inconsistencies, as well as research that indicated that GPA is just as relevant as placement scores for determining student success.[3] This revised policy—and its impact on student outcomes—is the primary focus of this evaluation.

[1] Schak, O., Metzger, I., Bass, J., McConn, C., & English, J. (2017).Developmental Education: Challenges and Strategies for Reform

[2] Ibid.

[3] Massachusetts Board of Higher Education, Task force on Transforming Developmental Math Education. (2013). *Final Report From the Task Force on Transforming Developmental Math Education.*

The Developmental Math Pilot Program has completed three years of a pilot phase of experimentation and innovation (FY 2015, FY 2016 and FY 2017), and campuses were offered the option to continue or revise their pilot implementation in fall 2015.

This report addresses the following research questions:

> *RQ1a*: Did new assessment policies have impact on the placement of students in developmental education courses?
>
> *RQ1b*: Did placement of students in particular courses have impact on students' successful completion of both developmental education courses and their first gateway college-level mathematics course?
>
> *RQ1c*: If students took mathematics courses after the first gateway college-level mathematics course, how did they perform?

This is the first of two planned reports addressing these research questions. This report includes data from one baseline (pre-pilot) year (FY 2014) and the first two years (FY 2015 and FY 2016) in which pilots were active. The next quantitative report will primarily address comparisons between students' performance in (FY 2014) to students' performance in FY 2017 and FY 2018.

Results

RQ1a: Did new assessment policies have impact on the placement of students in developmental education courses?

This section presents findings from statistical analyses that compared rates of participation in developmental mathematics, enrollment in at least one credit mathematics course, and completion of at least one credit mathematics course during the pilot to rates just prior to pilot (FY 2014). Only institutions implementing a pilot standard during FY 2015 and/or FY 2016 were included in these analyses. We compared students who enrolled for the first time at one of these institutions during the pilot period (FY 2015 or FY 2016) to students who enrolled for the first time at one of these institutions during the baseline period (FY 2014). Findings comparing students who were determined to be college math ready using a pilot standard (during FY 2015 or FY 2016) to similar students from the baseline period (FY 2014) are also presented.

We used rigorous, quasi-experimental, matched comparison group designs to draw strong conclusions about the impact of the pilots (Cook and Campbell 1979).[4] Technical descriptions of the statistical methods are presented in Appendix A.

Descriptive analyses summarizing students' placement in developmental mathematics presented in combination with the descriptive analyses presented in response to question 1b.

A complex picture emerged regarding the impact of the Developmental Math Placement pilot. Compared with students who enrolled in a pilot campus one year prior to pilot, students at pilot campuses were more likely to enroll in a gateway college-level mathematics course within two years of enrollment after the pilot began, and were also more likely to complete a gateway college-level mathematics course within two years of enrollment after the pilot began. However, students who enrolled in a pilot campus while the pilot was being implemented were no more or less likely to enroll in a developmental mathematics course (within two years of enrollment) than students who enrolled at a pilot campus prior to the period of pilot implementation.

Impacts of policy implantation that were statistically significant are summarized in Table 1 through Table 6 below. Each table notes three levels of significance, or "p-values." Lower p-values correspond to a higher degree of confidence that a result represents a true difference between groups rather than random variation in the data.

[4] Treatment and comparison groups were matched on gender, race/ethnicity, low-income status, English language learner status, disability status, grade level, rate of school attendance, and pre-intervention test performance.

The tables provide odds ratios, indicating the degree of impact of the math placement pilot.[5] An odds ratio greater than one indicates that the outcome was more likely after pilot began than before the pilot began, while an odds ratio less than one indicate that the outcome was less likely after pilot began than before the pilot began. For example, an odds ratio of 1.3 for developmental math taking means that students who enrolled at piloting campuses for the first time in FY 2015 or FY 2016 were 1.3 times as likely as students who enrolled at piloting campuses for the first time in FY 2014 to enroll in one or more developmental mathematics courses within two years of their initial enrollment. An odds ratio of 0.7 for Credit math completing means that students who enrolled at piloting campuses for the first time in FY 2015 or FY 2016 were 0.7 times as likely as students who enrolled at piloting campuses for the first time in FY 2014 to complete one or more college-level mathematics courses within two years of their initial enrollment.

The tables also provide a 95 percent confidence interval (CI), recognizing that the sample of students in the study might be somewhat different from the full population from which they were drawn (all public colleges and universities in the Commonwealth of Massachusetts). The confidence interval provides a range that has a 95 percent chance of including the true value of the odds ratio for that population.

Developmental Mathematics Course Taking

Table 1 shows that students at state universities, Asian students, and African American students were more likely to enroll in a developmental mathematics course—within two years of initial enrollment—after the pilot began.

Table 1. Developmental Math Taking – FY 2014 vs. FY 2015 and FY 2016 – All Students

Student Group	Odds Ratio	95% CI
All	N.S.	-
Community College Students	N.S.	-
State University Students	1.20***	[1.12, 1.28]
Men	N.S.	-
Women	N.S.	-
African American	1.24***	[1.06, 1.47]
Asian	1.30*	[1.00, 1.70]
Hispanic	N.S.	-
White	N.S.	-

*$p < .05$, **$p < .01$, ***$p < .001$. *Note:* Only statistically significant results are presented. N.S. means "not significant".

Table 2 shows that all students, community college students, men, women, Asian students, Hispanic students, and White students determined to be college math ready under any standard, as well as

[5] Researchers seeking effect sizes can calculate them directly from the reported odds ratios by subtracting one (1). Effect sizes for MCAS results were calculated separately and are reported in relevant tables and appendices.

students to be college math ready under Pilot Standard A, and students determined to be college math ready under Pilot Standard B, were less likely to enroll in developmental mathematics within two years of enrollment than similar students who enrolled in a pilot institution during the baseline period (FY 2014).

Table 2. Developmental Math Taking – FY 2014 vs. FY 2015 and FY 2016 – Pilot Students Only

Student Group	Odds Ratio	95% CI
All	0.42***	[0.31, 0.56]
Community College Students	0.33***	[0.22, 0.48]
State University Students	N.S.	-
Pilot A Participants	0.47***	[0.33, 0.68]
Pilot B Participants	0.32***	[0.20, 0.51]
Men	0.41***	[0.32, 0.53]
Women	0.42***	[0.30, 0.60]
African American	N.S.	-
Asian	0.48***	[0.32, 0.72]
Hispanic	0.50***	[0.34, 0.73]
White	0.34***	[0.27, 0.45]

*$p < .05$, **$p < .01$, ***$p < .001$. *Note:* Only statistically significant results are presented. N.S. means "not significant".

College-level Mathematics Course Taking

Table 3 shows that all students, students enrolled at community colleges, students enrolled at 4-year colleges, women, and White students were more likely to enroll in a credit mathematics course—within two years of initial enrollment—after the pilot began.

Table 3. Credit Math Taking – FY 2014 vs. FY 2015 and FY 2016 – All Students

Student Group	Odds Ratio	95% CI
All	1.41**	[1.11, 1.79]
Community College Students	1.58*	[1.03, 2.41]
State University Students	1.14***	[1.06, 1.22]
Men	N.S.	-
Women	1.47*	[1.08, 2.00]
African American	N.S.	-
Asian	N.S.	-
Hispanic	N.S.	-
White	1.41*	[1.04, 1.91]

*$p < .05$, **$p < .01$, ***$p < .001$. *Note:* Only statistically significant results are presented. N.S. means "not significant".

Table 4 shows that all students, community college students, men, women, Asian students, Hispanic students, and White students determined to be college math ready under any standard, as well as students to be college math ready under Pilot Standard A, and students determined to be college math ready under Pilot Standard B, were more likely to enroll in a college-level mathematics course within two years of enrollment than similar students who enrolled in a pilot institution during the baseline period (FY 2014).

Table 4. Credit Math Taking – FY 2014 vs. FY 2015 and FY 2016 – Pilot Students Only

Student Group	Odds Ratio	95% CI
All	1.81***	[1.70, 1.92]
Community College Students	2.43***	[1.41, 4.19]
State University Students	N.S.	-
Pilot A Participants	3.88***	[2.27, 6.63]
Pilot B Participants	1.33***	[1.23, 1.44]
Men	2.33**	[1.28, 4.24]
Women	2.27**	[1.32, 3.93]
African American	N.S.	-
Asian	2.97***	[2.03, 4.36]
Hispanic	3.52***	[2.13, 5.80]
White	2.13*	[1.19, 3.81]

*$p < .05$, **$p < .01$, ***$p < .001$. *Note:* Only statistically significant results are presented. N.S. means “not significant”.

College-level Mathematics Course Passing

Table 5 shows that all students, students enrolled at community colleges, students enrolled at 4-year colleges, women, Asian students, and White students were more likely more likely to complete a credit mathematics course—within two years of initial enrollment—after the pilot began.

Table 5. Credit Math Passing – FY 2014 vs. FY 2015 and FY 2016 – All Students		
Student Group	Odds Ratio	95% CI
All	1.31**	[1.07, 1.61]
Community College Students	1.44*	[1.02, 2.03]
State University Students	1.16***	[1.08, 1.25]
Men	N.S.	-
Women	1.33*	[1.01, 1.75]
African American	N.S.	-
Asian	1.36*	[1.04, 1.80]
Hispanic	N.S.	-
White	1.31*	[1.02, 1.69]

*p < .05, **p < .01, ***p < .001. *Note:* Only statistically significant results are presented. N.S. means "not significant".

Table 6 shows that all students, community college students, men, women, Asian students, Hispanic students, and White students determined to be college math ready under any standard, as well as students to be college math ready under Pilot Standard A, and students determined to be college math ready under Pilot Standard B, were more likely to complete a college-level mathematics course within two years of enrollment than similar students who enrolled in a pilot institution during the baseline period (FY 2014).

Table 6. Credit Math Passing – FY 2014 vs. FY 2015 and FY 2016 – Pilot Students Only		
Student Group	Odds Ratio	95% CI
All	1.67***	[1.57, 1.78]
Community College Students	2.11***	[1.38, 3.24]
State University Students	N.S.	-
Pilot A Participants	2.99***	[1.98, 4.55]
Pilot B Participants	1.30***	[1.20, 1.41]
Men	2.05**	[1.31, 3.22]
Women	1.85**	[1.21, 2.83]
African American	N.S.	-
Asian	2.33***	[1.73, 2.89]
Hispanic	2.38***	[1.61, 3.52]
White	1.84**	[1.18, 2.89]

*p < .05, **p < .01, ***p < .001. *Note:* Only statistically significant results are presented. N.S. means "not significant".

RQ1b: Did placement of students in particular courses impact students' successful completion of both developmental education courses and their first gateway college-level mathematics course?

This section describes the percentage of students taking at least one gateway, college-level mathematics course as well as the percentage of students successfully completing developmental education and college-level mathematics courses. The section begins with a summary of the percentage of students progressing from taking a developmental mathematics course as a first mathematics course to **taking** at least one college-level mathematics course within two years of their initial enrollment. We show differences in outcomes at the course-level and by institution type (i.e., percentages for community colleges versus state universities). We then show the percentage of students **completing** their first mathematics course, including both for those beginning in developmental and college-level mathematics. This section concludes with an exploration of the differences for both categories of students by initial mathematics placement, disaggregated for subgroups of interest (i.e., students beginning in FY 2014 versus FYs 2015 or 2016), gender, and race.

Table 7. Number and Percent of Developmental Math Students Who Took and Completed One or More College-Level Math Courses

Institution	# (%) Students Who Took College-Level Math		# (%) Students Who Completed College-Level Math	
	Count	%	Count	%
Berkshire Community College	187	22.8%	154	18.8%
Bristol Community College	1,002	26.4%	755	19.9%
Bridgewater State University	791	58.9%	724	53.9%
Bunker Hill Community College	1,277	29.2%	928	21.2%
Fitchburg State University	512	49.1%	389	37.3%
Cape Cod Community College	203	20.2%	141	14.0%
Framingham State University	286	49.2%	194	33.4%
Greenfield Community College	137	16.5%	119	14.4%
Holyoke Community College	770	19.9%	621	16.1%
Mass Bay Community College	267	18.0%	177	11.9%
Massachusetts College of Liberal Arts	1	4.2%	1	4.2%
Massasoit Community College	1,115	26.9%	718	17.3%
Salem State University	146	27.0%	106	19.6%
Middlesex Community College	492	16.0%	352	11.5%
Westfield State University	59	45.4%	53	40.8%
Mt. Wachusett Community College	825	39.4%	618	29.5%
Worcester State University	298	49.7%	222	37.0%
North Shore Community College	344	31.2%	248	22.5%
Northern Essex Community College	886	28.0%	634	20.0%
Quinsigamond Community College	858	26.5%	677	20.9%
Roxbury Community College	184	21.2%	134	15.4%
Springfield Tech Community College	1,156	29.1%	900	22.7%
Total	11,796	28.0%	8,865	21.1%

Overall, a much higher percentage of students whose first mathematics course was at the college level (versus students beginning in developmental mathematics) completed at least one credit mathematics course within two years than students whose first mathematics course was developmental. Overall, 82.9 percent of students whose first mathematics course was at the college level completed college level mathematics course within two years of enrollment, and 21.1 percent of students whose first mathematics course was developmental completed a college level mathematics course within two years—representing a difference of over 61 percentage points. This difference can be partially explained by two contextual factors: 1) students who are required to take developmental mathematics did not demonstrate the mathematical proficiency required to take a college-level mathematics course at their

time of enrollment, and 2) students beginning with developmental mathematics must take at least one additional mathematics course to be eligible for their first college-level mathematics course.

Share of students who took college-level mathematics

Most students whose first mathematics course was developmental did not take a college-level mathematics course within two years of initial enrollment. Across all piloting institutions, 28.0 percent of students who first enrolled in FY 2014, FY 2015, or FY 2016 and whose first mathematics course was developmental subsequently **took** a college-level mathematics course within two years**.** Table 7 shows the number and percentage of students who first enrolled in FY 2014, FY 2015, or FY 2016 at piloting sites whose first mathematics course taken was a developmental mathematics course. The percentage of students who progressed to credit mathematics varied by institution type, with 4-year institutions reporting higher percentages of students taking a college-level mathematics course after taking a developmental mathematics course as a first course.

Of the piloting sites, Bridgewater State University (58.9 percent), Worcester State University (49.7 percent), and Framingham State University (49.2 percent) had the highest percentages of students transition from taking a developmental mathematics course as first mathematics course to taking a college-level mathematics course within two years of enrollment. Among community colleges, Mt. Wachusett Community College (39.4 percent), North Shore Community College (31.2 percent), and Bunker Hill Community College (29.2 percent), had the highest percentages of students beginning in developmental mathematics progress to taking a college-level mathematics course within two years.

Of piloting sites, Massachusetts College of Liberal Arts (4.2 percent), Middlesex Community College (16.0 percent), and Greenfield Community College (16.5 percent) had the lowest percentages of students transition from taking a developmental mathematics course as a first course to taking a college-level mathematics course within two years of enrollment. The underlying profiles differ considerably: at MCLA, 1 of 24 students who took a developmental mathematics course as a first mathematics course subsequently took at least one college-level course within two years, whereas 492 of 3,069 students did so from Middlesex Community College.

Table 1a, found in Appendix B (Excel Workbook), shows that, generally, the lower in the developmental mathematics sequence that a student begins, the less likely they are to take at least one college-level mathematics course. For example, at Roxbury Community College, of students who enrolled in the most elementary developmental mathematics course offered at that campus, MAT 087, Basic Math with Lab, 17.4 percent (110 of 631) students subsequently took a college-level course within two years. For the next course in the sequence at Roxbury Community College, MAT 088, Intro to Algebra with Lab, 26.5 percent (52 of 196) of students did so, and in the highest developmental mathematics course in the sequence, MAT 099, Intermediate Algebra with Lab, 53.7 percent (22 of 41) of students took a college-level mathematics course within two years.

The percentage of students successfully taking at least one college-level mathematics course after beginning in developmental mathematics is very low for some courses at some institutions. For example, only 6.9 percent (17 of 248) of Mass Bay Community College students whose first mathematics

course was MAT085, Arithmetic and Study Skills, subsequently took at least one college-level mathematics course. At Cape Cod Community College, 4.3 percent (8 of 185) of students who took MAT 010, Fundamental Arithmetic, did so. At some institutions, the percentages are even lower for students who begin in some developmental mathematics courses with smaller enrollments.

Share of students who completed college-level mathematics

Students who began in developmental mathematics

A majority—75.0 percent—of students across all piloting institutions during the evaluation period (first enrolled in FYs 2014, 2015, or 2016) who began in developmental mathematics and progressed to taking at least one college-level mathematics course completed at least one such course. By comparison, the same figure for students who began in college-level mathematics was 83 percent. As shown in Table 7 above, for all piloting schools, 21.1 percent of students who began in developmental mathematics completed at least one college-level mathematics course within two years.

For students whose first mathematics course was developmental, state universities again generally saw higher shares of these students completing a college-level mathematics course within two years; four of the top performing institutions by this measure were state universities, as shown in Table (8).

Table 8. Percent of Students Whose First Math Course was Developmental Math

Institution	Percent
Bridgewater State University	53.9%
Fitchburg State University	37.3%
Worcester State University	37.0%
Framingham State University	33.4%
Middlesex Community College	29.9%

Greenfield Community College (14.4 percent), Cape Cod Community College (14.0 percent), and Mass Bay Community College (11.9 percent) had the three lowest percentages of students starting in developmental mathematics completing at least one college-level mathematics course within two years.

Similar to the share of students who took at least one college-level mathematics course who began in developmental mathematics, the lower in the developmental mathematics sequence a student began the less likely they were to complete at least one college-level course within two years of their initial enrollment. For example, 18.2 percent of Berkshire Community College students whose first mathematics course was developmental completed their first college-level mathematics course within two years. By comparison, 72 percent of students at this institution whose first mathematics course was college-level completed their first credit mathematics course within two years. At Berkshire Community College, the percentage of students passing at least one college-level mathematics course within two years ranged from as low as 2.4 percent for students taking Arithmetic II as their first mathematics

course to 50 percent for students taking Elementary Algebra VI as their first mathematics course. Students whose first mathematics course was college-level fared better, ranging from 50 percent (for students taking Differential Equations as a first mathematics course) to 87.9 percent (for students taking Calculus I as a first mathematics course). These results are drawn from 1b in Appendix B (Excel Workbook).

Students who began in college-level mathematics

Across all piloting schools, 82.9 percent of students whose first mathematics course was college-level completed at least one such course within two years. Table 9 shows the pilot institutions with the highest percentage of students whose first mathematics course was college-level and who also completed a college-level mathematics course within two years. With one exception, Springfield Technical Community College, the institutions with the highest completion percentages were state universities. A complete listing of results, by institution, is included in Appendix B (Excel Workbook).

Table 9. Percent of students Whose First Math was College-level

Institution	Percent
Massachusetts Maritime Academy	93.7%
Bridgewater State University	92.9%
Massachusetts College of Art	91.7%
Worcester State University	88.7%
Springfield Technical Community College	88.4%

Cape Cod Community College (70.5 percent), Northern Essex Community College (67.5 percent), and Massasoit Community College (45.7 percent) had the lowest percentage for students starting in college-level mathematics completing at least one college-level mathematics course.

Differences by institution type (community colleges and state universities)

Regardless of whether a student's first mathematics course was developmental or college-level, a higher percentage of students at state universities completed a credit mathematics course within two years. As shown in Table 10 below, Four-year institutions had seven of the highest percentages of students completing college-level mathematics, with one community college, Springfield Technical Community College, achieving the fifth-highest percentage. In total, 36.2 percent of state university students whose first mathematics course was developmental subsequently completed a college-level mathematics course within two years, compared to 19.6 percent of community college students. Across piloting institutions, the percentages of community college students whose first course was developmental ranged from 11.9 percent to 29.9 percent, and for state university students the percentages ranged from 33.4 percent to 53.9 percent.

Table 10. Percent of Students Who Complete College-level Math by Initial Course Type		
Institution	Percent of Students Who Complete College-Level Math After 1st Developmental Math Course	Percent of Students Who Complete College-Level Math After 1st College-Level Math Course
Bridgewater State University	**53.9%**	**92.9%**
Fitchburg State University	**37.3%**	**86.6%**
Worcester State University	**37.0%**	**88.7%**
Framingham State University	**33.4%**	**86.7%**
Middlesex Community College	29.9%	77.5%
Mt Wachusett Community College	29.5%	79.8%
Springfield Technical Community College	22.7%	88.4%
North Shore Community College	22.5%	73.6%
Bunker Hill Community College	21.2%	80.4%
Quinsigamond Community College	20.9%	84.1%
Northern Essex Community College	20.0%	67.5%
Bristol Community College	19.9%	79.6%
Salem State University	**19.6%**	**82.6%**
Berkshire Community College	18.2%	72.0%
Massasoit Community College	17.4%	45.7%
Holyoke Community College	16.1%	84.7%
Roxbury Community College	15.4%	71.6%
Greenfield Community College	14.4%	85.0%
Cape Cod Community College	14.0%	70.5%
Mass Bay Community College	11.9%	75.3%
Massachusetts Maritime Academy	*	**93.7%**
Massachusetts College of Art	*	**91.7%**
Westfield State University	*	**87.6%**
Massachusetts College of Liberal Arts	*	**84.5%**
Total unweighted average	23.8%	80.4%
CC unweighted average	19.6%	75.7%
SU unweighted average	36.2%	88.3%

*No developmental courses offered

Across all piloting state universities, 88.3 percent of students whose first mathematics course was college-level completed a college-level mathematics course within two years of their initial enrollment.

A lower percentage of community college students (75.7 percent) whose first mathematics course was college-level completed a college-level mathematics course within two years of their initial enrollment.

Across all community colleges, the percentage of students whose first mathematics course was college-level and completed a college-level mathematics course within two years of their initial enrollment ranged from 45.7 percent to 85.0 percent. At state universities, credit mathematics course completion percentages for students whose first mathematics course was college-level ranged from 86.7 percent to 92.9 percent.

Relative to community colleges, state universities offered fewer developmental mathematics courses. For example, Massachusetts Maritime Academy, Massachusetts College of Art, Westfield State University, and Massachusetts College of Liberal Arts offered no developmental-level mathematics courses during the focus period. The other four-year institutions participating in the pilots offered no more than two developmental mathematics courses. In contrast, community colleges offered at least four different developmental mathematics courses, and Springfield Technical Community College offered 17 developmental-level courses.

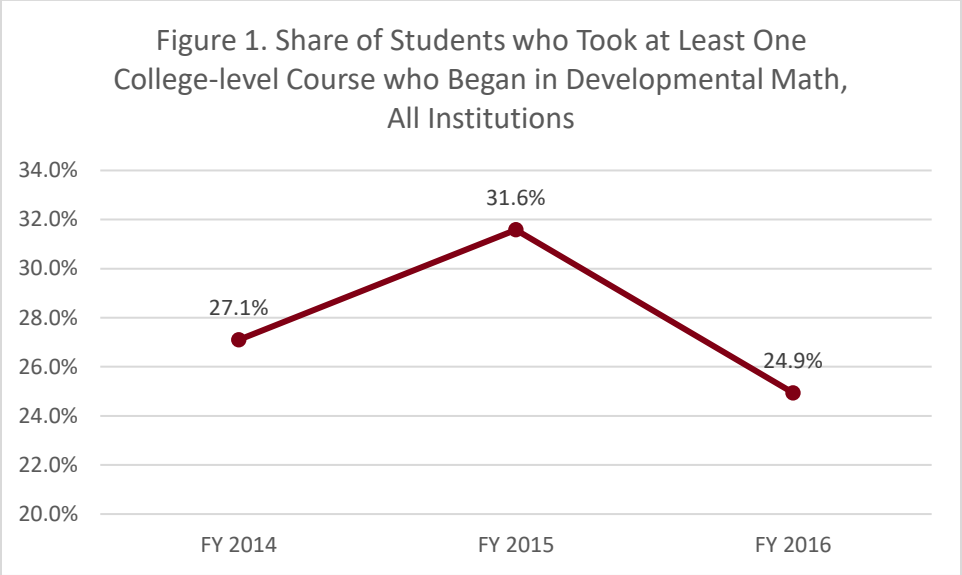
Variation by subgroup

When students who enrolled at a piloting institution the year immediately before (FY 2014) and years immediately after (FY 2015 and FY 2016) first implementation of the mathematics placement pilots are compared, a slightly higher percentage of students, **regardless of first mathematics course**, completed at least one college-level mathematics course, within two years of their initial enrollment, after implementation of the pilots. Among students in the FY 2014 cohort, 46.4 percent completed at least one college-level mathematics course within two years, regardless of first mathematics course taken. In total, 50.1 percent of students from the FY 2015 and FY 2016 cohorts combined completed at least one college-level mathematics course within two years.

Comparing the years immediately before (FY 2014) and after (FY 2015 and FY 2016) first implementation of the pilots, **by type of first mathematics course taken (developmental versus college-level)**, students whose first mathematics course was developmental fared slightly worse in the years after the pilots began. However, a higher percentage of students whose first mathematics course was in college-level performed better after the pilots began. In the FY 2014 cohort of **students starting in developmental mathematics**, 22.5 percent **completed** at least one college-level mathematics course within two years. In the FY 2015 and FY 2016 cohorts, 22.3 percent of students did so. In the FY 2014 cohort of students **starting in college-level mathematics**, 77.1 percent **completed** at least one credit mathematics course within two years. In the FY 2015 and FY 2016 cohorts, 78.9 percent of students did so.

The same general trends were observed for students who began in developmental mathematics and **took** at least one college-level mathematics course within two years. Among students in the FY 2014 cohort, 27.1 percent of students across all institutions (4,196 of 15,486) whose first mathematics course was developmental took at least one college-level mathematics course within two years, as shown in Figure 1 Combining students from the FY 2015 and FY 2016 cohorts, 28.6 percent (7,600 of 26,605) of students whose first mathematics course was developmental took at least one college-level mathematics course within two years. However, the percent of students taking a developmental

mathematics course who subsequently took a college-level mathematics course was actually lower for students in the FY 2016 cohort than for students in the FY 2014 cohort.



Differences by Gender

A slightly higher percentage of women completed a first college-level mathematics course within two years, for both students whose first mathematics course was developmental as well as for students whose first mathematics course was college-level, as shown in Table 1d in Appendix B (Excel Workbook). The percentage of women who started in developmental mathematics who completed a college-level mathematics course within two years (21.5 percent) was slightly higher than the percentage of men who did so (20.6 percent). Similarly, 85.1 percent of women whose first mathematics course was college level completed a college level course within two years, while 80.7 percent of men whose first mathematics course was college level did so.

However, despite outpacing men in both (developmental and college-level mathematics at entry), a slightly lower percentage of all women, regardless of the type of first mathematics course, complete at least one college-level mathematics course within two years. Overall (again, combining both students who started in developmental and college-level mathematics), 49.5 percent of men completed at least one college-level mathematics course within two years, while 48.2 percent of women did so. This is because a higher percentage of men (43.5 percent) took a first mathematics course that was college-level relative to women (40.8 percent).

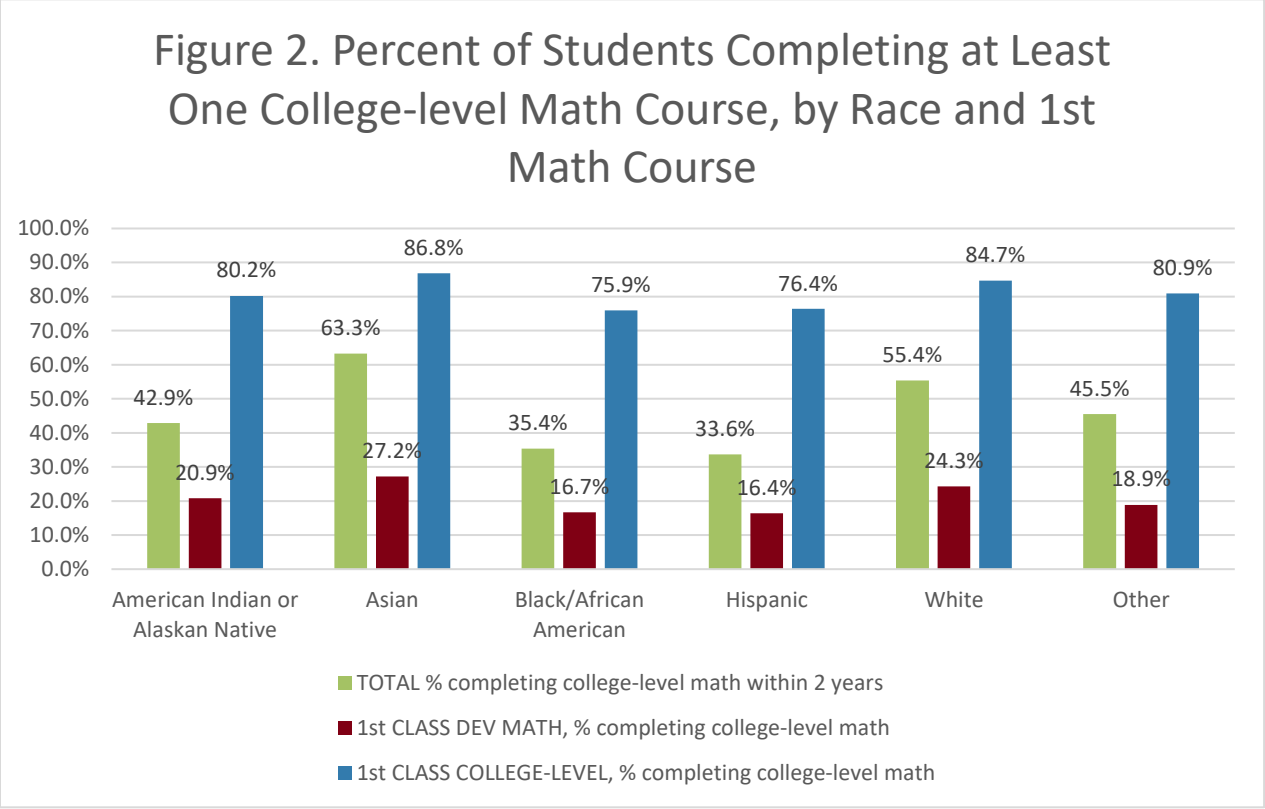
A slightly smaller percentage of women **took** a college-level mathematics course if their first mathematics course was developmental, as shown in Table X. Across all institutions, 27.9 percent of women, compared to 28.2 percent of men, took a college-level mathematics course within two years after beginning in developmental mathematics.

Table 11. Number and Percent of Students Who Took College-Level Math Who Began in Developmental Math by Gender

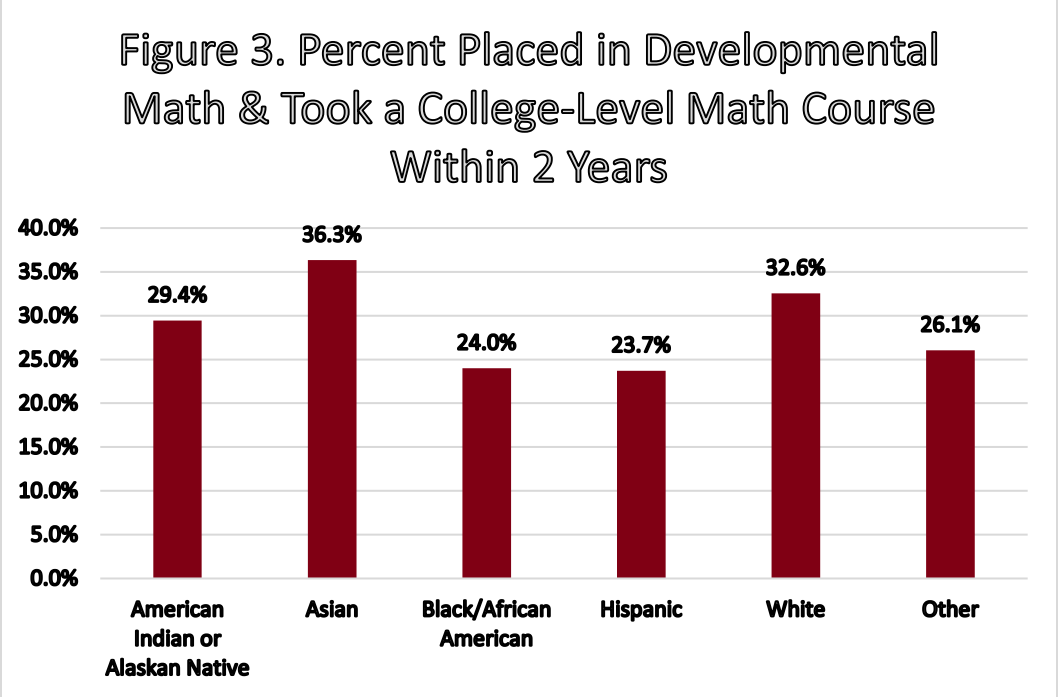
	# (Percent) of Students Who Took College-Level Math			
	Men		Women	
Institution	Count	Percent	Count	Percent
Berkshire Community College	85	21.3%	102	24.3%
Bristol Community College	403	24.9%	599	27.6%
Bridgewater State University	227	49.3%	564	63.9%
Bunker Hill Community College	638	30.8%	639	27.9%
Fitchburg State University	213	45.9%	299	51.6%
Cape Cod Community College	102	22.0%	101	18.6%
Framingham State University	101	47.4%	185	50.3%
Greenfield Community College	58	16.9%	78	16.3%
Holyoke Community College	347	20.9%	422	19.2%
Mass Bay Community College	151	20.1%	114	15.8%
Massachusetts College of Liberal Arts	0	0.0%	1	5.3%
Massasoit Community College	514	26.6%	601	27.1%
Salem State University	51	26.4%	95	27.4%
Middlesex Community College	219	15.8%	273	16.3%
Westfield State University	44	51.8%	15	33.3%
Mt. Wachusett Community College	277	33.0%	534	44.2%
Worcester State University	118	46.3%	180	52.2%
North Shore Community College	186	32.9%	158	29.4%
Northern Essex Community College	458	32.0%	428	24.7%
Quinsigamond Community College	452	30.3%	406	23.2%
Roxbury Community College	54	18.9%	130	22.3%
Springfield Tech Community College	569	32.3%	587	26.6%
Total	5,267	28.2%	6,511	27.9%

Differences by Race

A higher percentage of Asian and White students completed one or more college-level mathematics courses within two years, regardless of whether their first mathematics course was developmental or college-level, as shown in Figure 2. By the same measure, lower percentages of African American and Hispanic students had the percentages of students that completed a college-level mathematics course within two years of enrollment.



Asian and White students also had the highest percentages of students who took a college-level mathematics course after being placed in developmental mathematics, as shown in Figure 2.



Variation by pilot type

An analysis of students who took and completed credit mathematics courses within two years was examined by institution and pilot type. Data for 8, 361 pilot students who took any course, not just mathematics courses, were examined. The majority of these students were women (n=5,174, 61.9 percent) and White (n=5,310, 63.5 percent). Compared to the full sample of 143,448 students, both women and Whites were overrepresented among the group of students determined to be college mathematics ready through the application of a pilot standard. In addition, African American students were slightly overrepresented among the sample of pilot participants and Hispanic students were slightly underrepresented among the group of students determined to be college mathematics ready through the application of a pilot standard.

Table 12 includes the number and percentage of students who took and completed credit mathematics by pilot type. Of the students deemed college mathematics ready by Pilot A1, 46 percent (n=2,877) took and 39.5 percent (n=2,472) completed a credit mathematics course within two years. A total of 803 students or 40.7 percent of students deemed college mathematics ready according to Pilot B took a credit mathematics course within two years, and 31.5 percent (n=622) completed a credit mathematics course within two years.

Table 12. Number and Percent of Students Who Took and Completed Credit Math by Pilot Type

	# (Percent) of students who took a credit math course within two years				# (Percent) of students who completed a credit math course within two years			
	No		Yes		No		Yes	
Pilot Type	Count	Percent	Count	Percent	Count	Percent	Count	Percent
A1	3,384	54.0%	2,877	46.0%	3,789	60.5%	2,472	39.5%
B	1,169	59.3%	803	40.7%	,1350	68.5%	622	31.5%

Data were also examined by institution, pilot standard and credit mathematics outcome (Table 3). Regardless of institution type or pilot standard used, a consistent pattern was found in that most students who took a credit course in two years also completed a credit course within two years.

Table 13 shows the number and percentage of students who took and completed a credit mathematics course within two years by institution. The data indicates that regardless of whether the student attended a community college or state university, many students who took a credit mathematics course within two years also completed a credit mathematics course in two years. For example, 46.4 percent (n=148) of students at Bristol Community College took a credit mathematics course within two years and 40.1 percent (n=128) of those students also completed a credit mathematics course within two years. Approximately, 79.8 percent (n=1,132) of students at Framingham State took a credit mathematics course within two years and 70.3 percent (n=997) of those students completed a credit mathematics course within two years.

Table 13. Number and Percentage of Students Who Took and Completed Credit Math Within Two Years

	# (Percentage) of students who took a credit math course within two years				# (Percentage) of students completed a credit math course within two years			
	No		Yes		No		Yes	
Institution	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Berkshire Community College	26	21.7%	94	78.3%	43	35.8%	77	64.2%
Bristol Community College	171	53.6%	148	46.4%	191	59.9%	128	40.1%
Bunker Hill Community College	2	100.0%	0	0.0%	2	100.0%	0	0.0%
Cape Cod Community College	107	51.2%	102	48.8%	136	65.1%	73	34.9%
Framingham State University	287	20.2%	1132	79.8%	422	29.7%	997	70.3%
Greenfield Community College	6	31.6%	13	68.4%	7	36.8%	12	63.2%
Holyoke Community College	121	44.0%	154	56.0%	145	52.7%	130	47.3%
Salem State University	553	83.7%	108	16.3%	580	87.7%	81	12.3%
Middlesex Community College	115	27.9%	297	72.1%	188	45.6%	224	54.4%
Westfield State University	1,466	74.0%	514	26.0%	1,497	75.6%	483	24.4%
Mt. Wachusett Community	185	41.0%	266	59.0%	236	52.3%	215	47.7%
North Shore Community College	0	0.0%	93	100.0%	17	18.3%	76	81.7%
Northern Essex Community College	322	62.6%	192	37.4%	349	67.9%	165	32.1%
Quinsigamond Community College	306	44.3%	385	55.7%	380	55.0%	311	45.0%
Roxbury Community College	958	80.2%	237	19.8%	1,028	86.0%	167	14.0%
Springfield Technial Community College	0	0.0%	1	100.0%	1	100.0%	0	0.0%

RQ1c: If students took mathematics courses after the first gateway college-level mathematics course, how did they perform?

Among all students at piloting sites that first enrolled in FY 2014, FY 2015, or FY 2016, and passed a gateway college-level mathematics course, 56.6 percent subsequently *took* at least one additional mathematics course for credit within two years of enrollment. In addition, 41.9 percent of students who first enrolled during the same period and completed their first gateway college-level mathematics course then *completed* at least one additional mathematics course for credit within two years of enrollment. Table 14 shows the number of students who took at least one college-level mathematics course (and potentially, additional mathematics courses) after completing their first gateway college-level mathematics course within two years of enrollment. Table 15 shows the number of students who completed at least one college-level mathematics course (and potentially, additional mathematics courses) within two years of enrollment. For a full table that shows a cross tabulation of the number of students taking and completing credit mathematics courses, see Appendix B (Excel Workbook).

Table 14. Credit Math Courses Taken within 2 Years (of Students Who Completed at least 1 Credit Math Course)

Courses (N)	Students (N)
1	33,979
2	22,574
3	9,504
4	4,083
5	1,495
6	805
7	470
8	208
9	81
10	70
11	22
12	12

Table 15. Credit Math Courses Completed within 2 Years	
Courses (N)	Students (N)
1	42,565
2	19,080
3	6,921
4	2,592
5	891
6	638
7	319
8	140
9	83
10	40
11	34

Among all sites participating in the pilot at some point in time, Massachusetts Maritime Academy had the highest percentage of students who completed an additional college-level mathematics course after completing a gateway mathematics course (84.3 percent), followed by Bridgewater State University (59.7 percent). Roxbury Community College had the lowest percentage of students who completed a college-level mathematics course after completing a gateway college-level mathematics course (12.7 percent), followed by Massachusetts College of Art (15.4 percent). Table 16 shows the number and share of students who completed multiple college-level mathematics courses by institution.

Table 16. Students Who Completed 2 or More Credit Math Courses, by Institution				
	Completed 1 course, only, for college credit		Completed 2 or more credit courses	
Institution	Count	Row N %	Count	Row N %
Berkshire Community College	765	64.4%	423	35.6%
Bristol Community College	2,912	72.7%	1,091	27.3%
Bridgewater State University	3,451	40.3%	5,115	59.7%
Bunker Hill Community College	3,332	65.3%	1,770	34.7%
Fitchburg State University	1,896	67.8%	899	32.2%
Cape Cod Community College	901	75.0%	301	25.0%
Framingham State University	1,919	58.5%	1,363	41.5%
Greenfield Community College	502	62.8%	297	37.2%
Massachusetts College of Art	11	84.6%	2	15.4%
Holyoke Community College	2,171	59.6%	1,469	40.4%
Massachusetts Maritime Academy	433	15.7%	2,323	84.3%
Mass Bay Community College	1,315	77.1%	390	22.9%
Massachusetts College of Liberal Arts	209	82.9%	43	17.1%
Massasoit Community College	2,707	68.4%	1,250	31.6%
Salem State University	1,611	66.8%	799	33.2%
Middlesex Community College	2,554	58.2%	1,833	41.8%
Westfield State University	2,044	56.8%	1,555	43.2%
Mt. Wachusett Community College	1,999	73.4%	723	26.6%
Worcester State University	1,866	52.8%	1,667	47.2%
North Shore Community College	1,732	55.3%	1,400	44.7%
Northern Essex Community College	1,906	59.9%	1,275	40.1%
Quinsigamond Community College	2,763	48.7%	2,915	51.3%
Roxbury Community College	641	87.3%	93	12.7%
Springfield Technical Community College	2,925	62.7%	1,742	37.3%
Total	42,565	58.1%	30,738	41.9%

Table 17 shows that the percentage of students who completed a gateway college-level mathematics course and at least one additional credit-bearing mathematics course increased slightly from FY 2014 to FY 2016. However, this percentage was highest for students in the FY 2015 cohort. Overall, 39.6 percent of students who began in FY 2014 completed at least one additional mathematics course. This rate increased to 45.9 percent for students who began in FY 2015, before decreasing slightly to 39.2 percent for students who began in FY 2016. The rate for all students who began after the mathematics placement pilots were underway (FY 2015 and FY 2016, combined) was 43.1 percent.

Table 17. Students Who Completed 2 or More Credit Math Courses within 2 Years of Enrollment, by Academic Year

	Academic Year 2014		Academic Year 2015		Academic Year 2016	
Institution	Count	Percent	Count	Percent	Count	Percent
Berkshire Community College	111	27.2%	174	42.6%	138	37.1%
Bristol Community College	659	31.5%	345	23.4%	87	20.0%
Bridgewater State University	1,336	54.6%	2,095	64.0%	1,684	59.1%
Bunker Hill Community College	451	30.0%	907	39.6%	412	31.5%
Fitchburg State University	350	38.2%	407	37.9%	142	17.7%
Cape Cod Community College	101	21.9%	111	28.3%	89	25.5%
Framingham State University	386	39.8%	644	48.1%	333	34.2%
Greenfield Community College	133	39.0%	123	37.7%	41	31.1%
Massachusetts College of Art	0	0.0%	2	40.0%	0	0.0%
Holyoke Community College	434	38.5%	696	44.6%	339	35.6%
Massachusetts Maritime Academy	572	80.6%	802	84.9%	949	86.2%
Mass Bay Community College	147	25.7%	144	23.7%	99	18.8%
Massachusetts College of Liberal Arts	43	17.1%	0	0.0%	0	0.0%
Massasoit Community College	235	23.1%	704	42.5%	311	24.3%
Salem State University	241	30.9%	315	35.2%	243	33.1%
Middlesex Community College	730	42.2%	868	49.3%	235	26.1%
Westfield State University	443	40.0%	782	53.1%	330	32.4%
Mt. Wachusett Community College	192	24.6%	311	29.5%	220	24.8%
Worcester State University	403	41.2%	709	53.9%	555	44.8%
North Shore Community College	771	47.4%	506	43.2%	123	36.7%

Northern Essex Community College	709	45.0%	441	38.6%	125	27.0%
Quinsigamond Community College	668	48.4%	1361	56.2%	886	47.2%
Roxbury Community College	39	15.1%	42	13.0%	12	7.9%
Springfield Technical Community College	693	38.1%	585	36.5%	464	37.3%
Total	9,847	39.6%	13,074	45.9%	7,817	39.2%

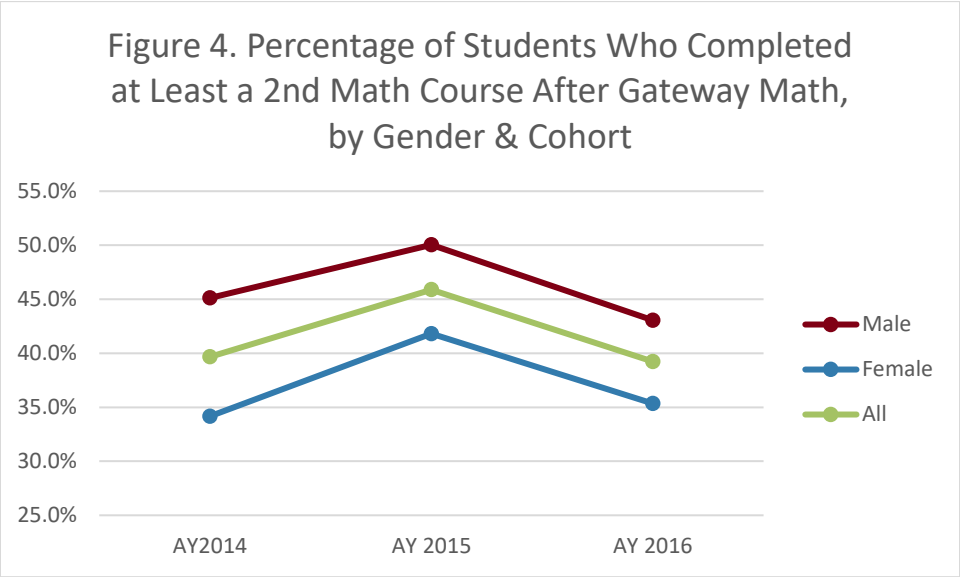
The percentage of students who completed at least one additional college-level mathematics course after completing a gateway course varied by gender. A higher percentage of men (46.4 percent) than women (37.5 percent) completed at least one college-level mathematics course after completing a gateway college-level mathematics course. Table 18 shows the number and share of students, by gender and institution, who completed at least one additional college-level mathematics course after completing a gateway course.

Table 18. Students Who Completed 2 or More Credit Math Courses within 2 Years of Enrollment by Gender

	Male		Female	
Institution	Count	Percent	Count	Percent
Berkshire Community College	241	40.5%	182	30.7%
Bristol Community College	699	35.8%	392	19.1%
Bridgewater State University	1,992	58.8%	3,123	60.3%
Bunker Hill Community College	1,103	40.3%	667	28.3%
Fitchburg State University	374	31.6%	525	32.6%
Cape Cod Community College	160	28.4%	141	22.1%
Framingham State University	458	40.0%	905	42.4%
Greenfield Community College	203	48.8%	90	24.0%
Massachusetts College of Art	2	40.0%	0	0.0%
Holyoke Community College	922	49.1%	535	30.7%
Massachusetts Maritime Academy	2,029	84.2%	294	85.0%
Mass Bay Community College	267	25.3%	123	19.5%
Massachusetts College of Liberal Arts	21	24.1%	22	13.3%
Massasoit Community College	659	32.6%	591	30.5%
Salem State University	323	35.4%	476	31.9%
Middlesex Community College	1,045	44.9%	788	38.3%
Westfield State University	693	41.8%	860	44.4%
Mt. Wachusett Community College	350	33.5%	370	22.7%
Worcester State University	729	48.1%	938	46.5%
North Shore Community College	703	45.4%	697	44.0%
Northern Essex Community College	813	45.0%	462	33.6%
Quinsigamond Community College	1,949	56.6%	966	43.2%
Roxbury Community College	50	18.5%	43	9.3%
Springfield Technical Community College	1,201	46.2%	541	26.1%
Total	16,986	46.4%	13,731	37.5%

This pattern was consistent over time, with a higher percentage of men than women in each of the three cohorts completing two or more credit mathematics courses within two years of enrollment, as shown in Figure 4. The percentage of students completing at least one additional mathematics course increased from FY 2014 to FY 2015 for both men (from 45.1 percent to 50.0 percent) and women (from 34.2 percent to 41.8 percent). The percentage of students completing one additional mathematics course decreased for both men and women in FY 2016, falling to 43.1 percent and 35.3 percent, respectively. Comparing before (FY 2014) and after (FY 2015 and FY 2016, combined) the mathematics placement pilots were underway, the percentage both men and women completing a second college-level mathematics course increased after the pilots began: men rose 2 percentage points to 47.1

percent and women rose 5 percentage points to 39.2 percent. For a full table on completion of two or more credit mathematics courses within two years of enrollment, by institution, by gender, and by year, please see Appendix B (Excel Workbook).



The percentage of students who completed at least one additional college-level mathematics course after completing a gateway course also varied by race. Asian students had the highest share of students completing at least a second mathematics course after gateway mathematics at 51.6 percent, followed by White students at 43.7 percent. Approximately one-third of students who were Hispanic (34.6 percent), African American (34.3 percent) and American Indian or Alaska Native (32.6 percent) completed two or more college-level mathematics courses.

This outcome was examined by race and institution. Completion rates by race were also examined by institution. The percentage of African American students who completed at least one additional college-level mathematics course was highest at Greenfield Community College. Completion rates were highest for Hispanic students (71.7 percent) and White students (85.3 percent) who attended Massachusetts Maritime Academy. For a full table on completion of two or more credit mathematics courses within two years of enrollment, by both institution and race, please see Appendix B (Excel Workbook).

The percentage of students completing at least a second college-level mathematics course after a gateway mathematics course peaked for all races in FY 2015, as shown in Figure 5. However, by FY 2016 these rates had declined across the board. The percentages for students of all races except White and "Other" fell below corresponding rates for the FY 2014 cohort. For a full table on completion of two or more credit mathematics courses within two years of enrollment, by race and year, please see the Appendix B (Excel Workbook).

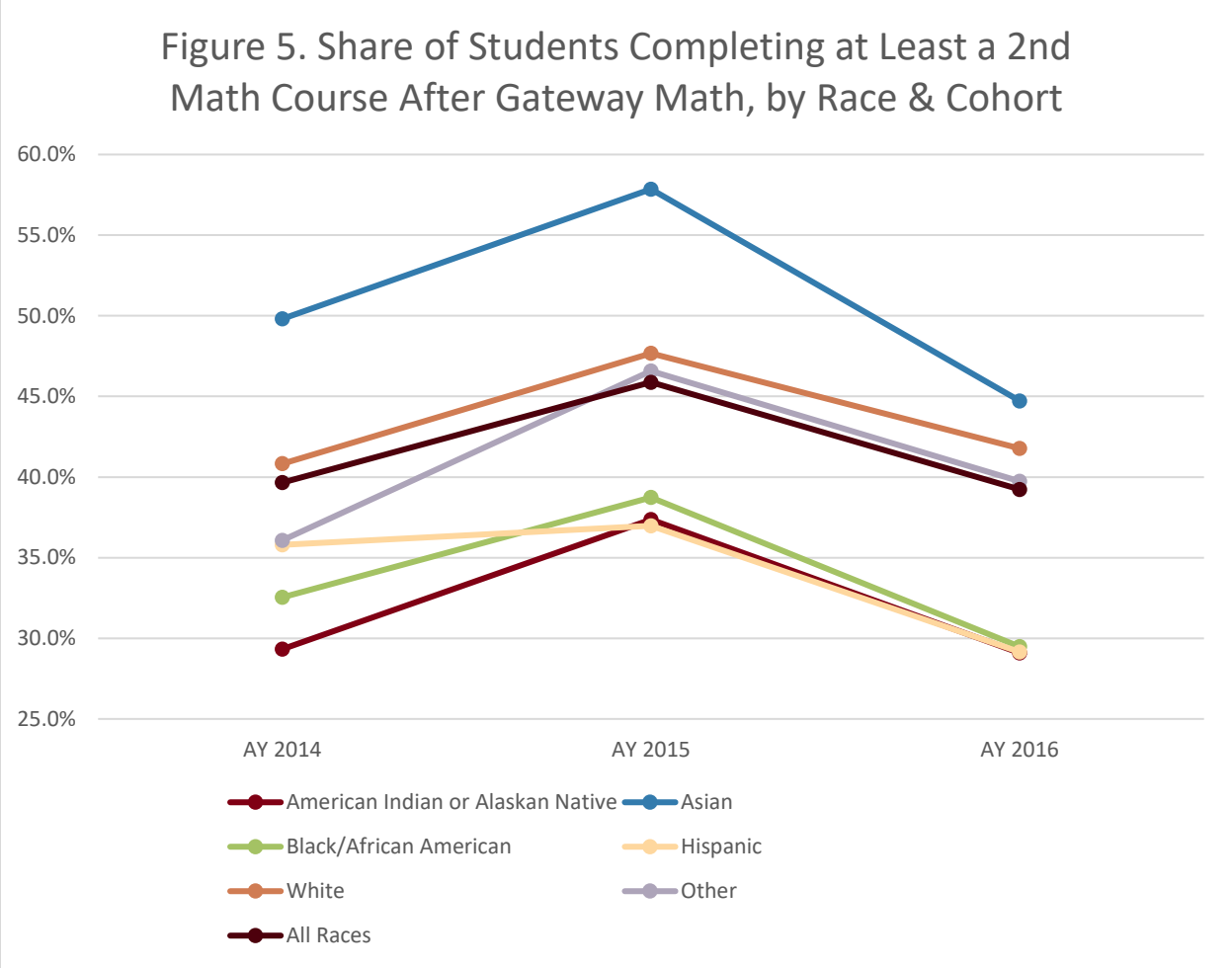


Figure 5. Share of Students Completing at Least a 2nd Math Course After Gateway Math, by Race & Cohort
60.0%
55.0%
50.0%
45.0%
40.0%
35.0%
30.0%
25.0%
AY 2014
AY 2015
AY 2016
American Indian or Alaskan Native
Asian
Black/African American
Hispanic
White
Other
All Races

Appendix A – Methodology

Regression Analyses

Differences in outcomes for students at piloting sites were assessed using a quasi-experimental matched comparison group design. Multi-level mixed-effect logistic regression analyses were conducted to assess the impact of participation on various student outcomes—enrollment in developmental mathematics course, enrollment in a gateway college-level mathematics course, and completion of one or more college-level mathematics courses within two years of enrollment—where students were nested within sites. Carefully selected covariates were included in each analysis to minimize the potential for bias. These covariates included gender, race/ethnicity, and full-time status at entry. This design enabled strong inferences about the impact of the Developmental Mathematics Pilot Program on the performance of students who enrolled at a piloting campus after pilot began as compared to the expected level of student performance in the absence of the intervention (i.e., students enrolled at piloting institutions prior to intervention).

Students were not randomly assigned to the intervention. Each site applied their own criteria to assign students to treatment. Therefore, it is likely that there were pre-intervention differences between participating students and non-participating students. These differences could have represented a significant threat (i.e., selection bias) to the validity of the study's findings. To reduce these differences substantially, propensity score weighting procedures were used, thereby improving the validity of the estimates of program impacts.

In total, 60 models pre-pilot students (first enrolled in FY2014) to post-pilot students (first enrolled in FY2015 or FY2016) were analyzed. For all 60 models, propensity score weighting results were within the parameters specified in the U.S. Department of Education's What Works Clearinghouse "Procedures and Standards Handbook" (2014). Intervention Data collected were pooled across years, reflecting an assumption that the effects of participation in online courses for credit recovery and acceleration were similar across years of the study.

Student outcomes were assessed two years after their initial enrollment. For example, if a student enrolled in a developmental math course within their first two years of enrollment, then that student was counted as a developmental mathematics course taker. Similarly, if a student enrolled in and completed one (or more) college-level mathematics courses within two years of enrollment, then that student was counted as having taken and completed a credit mathematics course.

Description of modeling procedures

For all students and for all subgroups of interest, mixed-effects logistic regression models were developed to assess the impact of the intervention on graduation, dropout, and college enrollment. Mixed-effects logistic regression contains both fixed effects and random effects. The following equation represents the general modeling procedure:

$$Y_{ij} = \beta_0 + \beta_1(Participant_{ij}) + \beta_2(Full\text{-}time_{ij}) + \beta_3(Asian_{ij}) + \beta_4(Black_{ij}) + \beta_5(Hispanic_{ij}) + \beta_6(White_{ij}) + \beta_7(Male_{ij}) + u_{0j} + e_{ij}$$

For $i = 1, \ldots, n_j$ students, and $j = 1, \ldots,$ n sites.

Random effects were included to account for site and individual student effects by adding a random error term for each site (u_i), and individual observations (e_{ij}). β_0 represents the intercept. The coefficients β_1 through β_7 represent the fixed effects of a given covariate on the outcome (Y_{ij}).

For this study, the coefficient of greatest interest was β_1, which represents the estimated impact of program participation on students' performance on the outcomes of interest. Outcomes of interest included enrollment in developmental mathematics within two years of initial enrollment, enrollment in a gateway college-level mathematics course within two years of initial enrollment, and completion of a college-level mathematics course within two years of initial enrollment. All outcomes (i.e., values for Y_{ij}) were binary (i.e., course enrollment and completion), so multi-level logistic regression analyses were conducted.

Developmental Mathematics Education Evaluation

Report on Complete Qualitative Analyses

June 29, 2018

UMASS DONAHUE INSTITUTE
Applied Research & Program Evaluation

Developmental Mathematics Education Evaluation

Report on Complete Qualitative Analyses

Prepared by the UMass Donahue Institute's
Applied Research & Program Evaluation Group

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Introduction

This brief summarizes high-level findings from interviews conducted during site visits to three institutions of higher education in Massachusetts—two community colleges and one state university. The site visits are one component of the Developmental Mathematics Education Evaluation conducted by the UMass Donahue Institute (UMDI) for the Massachusetts Department of Higher Education (DHE). A mixed methods approach combining qualitative and quantitative methods is being used to assess the implementation and impact of changes to mathematics developmental education placement policies at community colleges, state universities, and University of Massachusetts campuses.

Quantitative methods are being used to assess impact of the polices on student placement and success, while qualitative methods—including interviews with faculty and staff and an online survey of all pilot campuses administered in January 2018—will be used to and describe changes to service provision, stakeholder experiences and perspectives, and possible variation in implementation. This brief is the second of two deliverables summarizing results of qualitative data collection and analysis. Separate reports are prepared for the quantitative-focused evaluation components. A final quantitative evaluation repot will be submitted in October 2018.

The Developmental Math Pilot Program has completed three years of a pilot phase of experimentation and innovation (SY14–15, SY15–16 and SY16–17), and campuses were offered the option to continue or revise their pilot implementation in fall 2015. This revised policy—and its impact on student outcomes—is the primary focus of this evaluation.

Findings from interviews with administrators, faculty, and staff that are the focus of this report directly address the following research questions (three of four questions addressed by the overall evaluation):

> RQ2: Did implementation of the BHE policies have impact on provision of campus-level services (including the quality of instruction, student advising and support services, etc.) to recent high school graduates enrolled in mathematics developmental education courses?
>
> RQ3: What were the perspectives and experiences of faculty members, administrators, and staff members with regard to the implementation of the BHE policies, and were they aligned with DHE and BHE expectations and the intended impact on students?
>
> RQ4: Were BHE policies implemented with fidelity?

To address these questions, an analysis of interview findings addresses the following topics of inquiry:

- Perceived success of pilot implementation
- Modifications that were needed to support success
- Perceptions of the pilot and its impact on placement, enrollment, and student success

- Reflections on the pilot strategy compared to the traditional placement model
- Expectations of the pilot and ways administrative processes may need to adapt to support the pilots
- Impact on campus-level services

This report follows an initial report on qualitative findings released to DHE in March 2018 focused on findings from an online survey of all pilot campuses administered in January 2018. While this report builds off the initial qualitative brief, the scope and purpose of both are different in several ways. The initial qualitative brief provided a broad summary of how pilot campuses implemented the developmental math pilot as well as a high-level overview of changes in campus-level services since pilot strategies were implemented. In contrast, the site visit interviews provided data that facilitated a more in-depth analysis of pilot implementation at three of the 16 institutions identified as participating in the pilot as of January 2018. Please see the Report on Initial Qualitative Findings for a snapshot of each institutions' current pilot implementation strategy.

The remainder of this brief details the survey methodology, presents findings from the above topics of inquiry, and offers several points for discussion.

Methodology

UMDI in consultation with DHE selected the three institutions—Framingham State University, Holyoke Community College, and Middlesex Community College—for inclusion in the site visit interviews. Selection was purposeful and criteria were developed jointly with DHE to incorporate a range of institution types, approaches to the pilot (i.e., the pilot standard adopted), sizes of student population, geographic locations, and shares of students determined college-math ready through a pilot standard. The three campuses selected for visits also participated in the online survey of all pilot campuses administered in January 2018.

DHE first contacted selected sites in mid-March 2018 to requested their participation in this study, initially contacting the institution's president, copying the Institutional Research (IR) director and chief academic officer (CAO). All three sites that were initially selected elected to participate in the visits, which were conducted between mid- and late-April 2018. The visits consisted of three semi-structured interviews; two separate interviews were requested with administrators such as the director of advising, assessment director, developmental mathematics education coordinator, or others with knowledge of placement pilot implementation. A third interview was requested of one or two members of the mathematics faculty familiar with the developmental mathematics placement policies and procedures. The same data collection instrument was used for all respondents. A copy of the data collection instrument (interview guide), including prompts and questions, is included in Appendix A.

Findings

The findings of this report are broadly organized by research question, beginning with developmental math pilot implementation, providing snapshots of the three visited institutions' approach to the pilots and fidelity considerations between the GPA math placement pilot as intended by DHE/BHE goals and how institutions have structured the policy in the years since first adopting it. A second major finding area focuses on the perspectives and experiences of faculty members, administrators, and staff, including upper-level reflections on the success of the pilot and observed student outcomes. A final section explores potential impacts from the GPA math placement pilot on student support services; in this section, available support services are first summarized, then potential changes from the pilots are documented.

Key finding: institutions reported a variety of approaches to implementing the developmental math pilot standards.

- ✓ Despite a large share of students assessed under the math placement pilot at each institution, students' experiences with math placement had the potential to vary widely because of implementation differences, even between institutions adopting the same pilot standard.
- ✓ The use of ACCUPLACER and the effective discretion given to students to choose an initial placement varied by institution. In many cases, students placed by a pilot standard were still required or encouraged to take the placement test.
- ✓ Changes to the pilot since inception were generally described as minimal, and trended toward gradual expansion.
- ✓ Across institutions, respondents did not report major concerns with the fidelity of the implementation of the math placement pilot, although several areas of potential improvement were noted such as increasing training to advisors and expanding outreach to students to promote awareness of math placement methods.
- ✓ Administrators, faculty, and staff at two institutions expressed conflicting answers about precisely which pilot standard was in use at their institution. Also, the use of ACCUPLACER, even for students placed by the math placement pilots, was more pronounced at some campuses.

Key finding: administrators, faculty, and staff consistently described the pilot as a success.

- ✓ Respondents overall reported favorable observed student outcomes, such as increases in the number and share of students taking and completing college-level math and decrease in time to college-level math. Impacts in other areas, like assessing improved fit of students' initial math placements, were more ambiguous.

- ✓ Administrators, faculty, and staff also reported the pilot a success by criteria other than the goals of BHE and DHE for the policy (i.e., helping recent high school graduates advance more quickly to credit-bearing math courses). Observations included a better student experience and encouragement by results from the math GPA placement pilot to consider applying its principles to other subjects such as English.

- ✓ Although the study team did not explicitly ask about challenges or disadvantages to implementing the math placement pilot, administrators described several drawbacks. These included a lack of capacity to handle students' transcripts, students either not promptly sending transcripts or not enrolling in a math course their first semester, and administration ensuring that staff were on the same page about how the pilot should be implemented.

Key finding: the math placement pilot affected, at least in part, some campus-level services—especially in the area of course offerings; trends across institutions were difficult to discern.

- ✓ Institutions offered a range of support services for recent high school graduates in developmental math, most frequently tutoring, but also extending to resources preparing for the placement exam.

- ✓ Administrators, staff, and faculty reported at least some changes in several areas of campus-level services, attributed in part to the pilot. Respondents most frequently cited changes in the area of developmental and college-level math course offerings, and to a slightly lesser extent, student advising practices and instructional practices in developmental and college-level math.

- ✓ Many respondents acknowledged that changes in support services had occurred, but it was difficult for them to determine if the cause of those changes had been the math placement pilot, or other, concurrent initiatives.

Developmental Math Pilot Implementation

As a first topic during the site visits, administrators, faculty, and staff at each institution were asked to confirm and expand on the study team's understanding of the institution's approach to the pilot. Using institutions' responses to the online survey, respondents detailed what the pilot implementation currently looks like. This included confirming the pilot standard currently in use, date of implementation, process for math placement, and potential issues of students either being deemed college-math ready according to the pilot and not enrolling in college-level math, or conversely, the incidence of students placing into developmental math but challenging that placement. The study team also explored changes to the pilot since inception, including changes to standards used, eligible student populations, process/pathway for placement, course offerings, and administrative policies. To put these snapshots in context, the study team asked the interviewees to provide an overview of the developmental math sequence and curriculum, other concurrent, related initiatives, an overview of the advising process, and overview of administrative processes relevant to the pilot.

Of the three institutions visited, one used Pilot Standard A1, and two used Pilot Standard A3, as defined in Table 1. No institution reported using more than one pilot standard in the survey as defined by the Developmental Math Pilot Program.

Table 1
Pilot Standard Definitions

New Pilot Standard	Definition
A1	Student determined to be college ready based on a high school GPA of 2.7 or above.
A2	Student determined to be college ready based on a high school GPA of 2.7 and a "B" or higher in Algebra II.
A3	Student determined to be college ready based on a high school GPA of 2.7 and four years of high school math.

Institution profiles are presented below in tabular form to facilitate comparisons across campuses visited. In addition to exploring institutions' approach to the math placement pilot, the study team also focused on implementation questions, and specifically, the degree to which colleges and universities implemented the math placement pilots with fidelity. It is important to note that while the BHE policies for the pilot specify the placement standards higher education institutions may use, the study team is not aware of a prescribed application for their use. For example, we are not aware of a standard procedure to determine for which college-level math courses or eligible student populations the pilot should apply. As such, many of the questions of fidelity explored in this section relate to consistency in application within the institutions visited individually (see tables 2-4).

Institution profiles

Table 2
Framingham State University

Current pilot	**Standard used**	A3
	Eligible populations	All students
	Process/pathway for placement	All students are first placed by the pilot. Those who do not meet the pilot standard for college-level math are encouraged to take ACCUPLACER to try for a higher placement. STEM majors are also encouraged to take ACCUPLACER to place into the calculus course sequence; most do take the test. Advisors help ensure that the placement seems appropriate based on their high school math courses and their major. Students must follow the guidelines of the pilot (and

		ACCUPLACER, if they decide to take it) but may elect to enroll in a lower level than their placement if they do not feel adequately prepared.
	The incidence of students deemed college math ready but placed in developmental math	A handful of students elect to participate in the co-remediation alongside their first math class. (Co-remediation has replaced developmental math at FSU.)
	The incidence of students who initially place into developmental math but challenge that placement	Students who place into developmental math have the option to take ACCUPLACER to try to achieve a higher placement. Only rarely does someone in this situation obtain a sufficiently high score to move up.
Changes to pilot since inception	**Changes to standards used**	According to HEIRS, in 2014 and 2015, the pilot placement criteria included overall GPA of 2.7 or above and a math SAT score of 460 or above and taking a math course in the last year of high school. Interviewees were unable to confirm or refute this information.
	Changes to eligible populations	According to HEIRS, in 2014 and 2015, only students who did not require a course in the calculus sequence could be placed by the pilot. Interviewees were unable to confirm or refute this information.
	Changes to process/pathway for placement	STEM students used to be required to take ACCUPLACER, until 2017.
	Changes to course offerings	None directly as a result of the pilot; see “overview of developmental math sequence/curriculum” below for information on the new co-requisite model and other changes.
	Changes to administrative policies	None
	Changes (in pilot placement criteria or administrative processes) needed to support continued pilot implementation	No changes are critical to implement, but suggestions include looking more closely at the rigor of a student’s high school math courses, rather than simply at four years of high school math, or using SAT scores as another method for placement.
	Discontinued pilot standard(s)	None

Context	**Overview of developmental math sequence/curriculum**	In Fall 2017, FSU eliminated non-credit-bearing developmental math courses and switched to a co-requisite remediation model. Students who place into developmental math now enroll in college algebra alongside students who place into college-level math; however, they are required to take an additional 2-hour weekly lab to support their learning. These classes are also supported by Supplemental Instructors (i.e. teaching assistants). The math department has also revamped its math pathways / course sequencing in recent years, which affects placement.
	Other concurrent initiatives related to math education	FSU participates in the STEM Scholars program, which offers remediation to students interested in STEM fields who do not score well on ACCUPLACER.
	Overview of advising process	In the past, the registrar's office selected courses for incoming students, who did not meet with an advisor. Beginning in fall 2018, incoming students will be able to select their own classes with guidance from college staff.
	Overview of administrative processes relevant to the pilot (e.g., how transcripts are handled)	Not discussed

Table 3 Holyoke Community College		
Current pilot	**Standard used**	A3 (according to HEIRS, the school survey, and some college staff; other staff and faculty believe they are using A2)
	Eligible populations	High school graduates who graduated within three years of placement and are first-time degree seeking
	Process/pathway for placement	Eligible students who submit transcripts are placed by the pilot criteria; however, all students are required to take ACCUPLACER. Advisors then guide students in making a decision about their math placement, encouraging them to enroll in college-level math if they are placed into it.
	The incidence of students deemed college math ready but placed in developmental math	Students who are placed in college-level math by the pilot but whose ACCUPLACER scores indicate they should take developmental math have a choice of which level to take. Some may elect to remain in developmental math but further along in the sequence than ACCUPLACER indicates they should be (e.g. ACCUPLACER places them into 075 but they enroll in 085 or 095). This is a small number, about 2% of students who place into college-level math via the pilot that elect to enroll in developmental math.
	The incidence of students who initially place into developmental math but challenge that placement	All students are required to take ACCUPLACER; it is rare that a student who did not qualify for college-level math based on the pilot would score high enough on ACCUPLACER to place into college-level math. The only other method for placement is via an instructor signature, which is very rare.
Changes to pilot since inception	**Changes to standards used**	According to HEIRS, standard A was used in 2014-15 and standard B in 2015-16. There is some disagreement among interviewees about whether the standard recently switched from A2 to A3.
	Changes to eligible populations	Initially, the pilot was only open to students from a small number of local high schools, with a limit of 500 total students.

	Changes to process/pathway for placement	None
	Changes to course offerings	None
	Changes to administrative policies	None
	Changes (in pilot placement criteria or administrative processes) needed to support continued pilot implementation	Staff would like to improve communications to new students about the pilot. Initially, all students who met the pilot criteria for college-level math received a letter about their placement; staff plan to reinstate this process to inform students that they are eligible for college-level math based on the pilot. In addition, additional training or communication to advisors about the pilot standards would help ensure that all advisors have the same information. Currently, some advisors are better informed than others.
	Discontinued pilot standard(s)	None
Context	**Overview of developmental math sequence/curriculum**	There are three levels of developmental math, 075, 085 and 095. Students may take them either separately as traditional courses or together in a self-paced online course (with lab component and faculty support).
	Other concurrent initiatives related to math education	With the Complete College America initiative, prerequisites for some math courses have been lowered, so that students may now take college-level math prior to completing the entire developmental math sequence. Also, increased math tutoring is available to all students.
	Overview of advising process	All new students meet with an advisor in the advising center prior to enrolling for their first semester courses.
	Overview of administrative processes relevant to the pilot (e.g., how transcripts are handled)	The admissions office manually reviews transcripts and flags students as qualifying for college-level math via the pilot. This flag is visible to advisors and the Institutional Research department.

Table 4 Middlesex Community College		
Current pilot	**Standard used**	A1
	Eligible populations	New students who graduated high school in the past three years
	Process/pathway for placement	New students visit the testing center, where the staff (a Multiple Measures Specialist) goes over all available information with them. If a pilot-eligible student has a high school transcript with a 2.7 or higher GPA, they are informed that they may skip the math ACCUPLACER, though they must take it if they wish to enroll in higher-level math (i.e., calculus). The student then visits their advisor, who has access to any information available, including ACCUPLACER and the high school transcript. The advisor makes students aware of their placement options, and helps them enroll. Students who place into college-level math based on the pilot are encouraged to enroll in college-level math, but in rare cases they elect to enroll in developmental math. Students who do not submit high school transcripts prior to the registration deadline are placed based on ACCUPLACER.
	The incidence of students deemed college math ready but placed in developmental math	Rare; the placement would only be changed based on the preference of the student.
	The incidence of students who initially place into developmental math but challenge that placement	All students who place into developmental math via the pilot are required to take ACCUPLACER, offering them another opportunity to place into college-level math. Interviewees did not describe any students actively challenging their placement.
Changes to pilot since inception	**Changes to standards used**	Previously used standard B
	Changes to eligible populations	Initially, STEM majors were not eligible. At the start of the pilot, only students from 10 selected high schools were eligible. After the first semester, the pilot was opened to students from all high schools.

	Changes to process/pathway for placement	Initially all students were required to take ACCUPLACER, regardless of their high school GPA and pilot placement.
	Changes to course offerings	None
	Changes to administrative policies	Added processes related to transcript review; changed policies about testing so that students placed into college-level math by the pilot are now exempt.
	Changes (in pilot placement criteria or administrative processes) needed to support continued pilot implementation	None needed to support the current pilot; they hope to explore additional options for math placement based on other indicators, with the help of the Multiple Measures Specialists.
	Discontinued pilot standard(s)	None
Context	**Overview of developmental math sequence/curriculum**	Developmental math is offered only as self-paced modules completed online with classroom instruction/tutoring available. The modules included are partly tailored to students' majors.
	Other concurrent initiatives related to math education	The modular developmental math curriculum was implemented just prior to the pilot. In the past year, the testing center staff transitioned to being Multiple Measures Specialists who are helping Middlesex place students using a wider variety of information (rather than just ACCUPLACER).
	Overview of advising process	New students may first come in to Middlesex via the registrar's office (called the Student Information Center), the Admissions office, or the testing center. Once ACCUPLACER testing is complete, as necessary, students are seen by Advising Center staff; only after reaching sophomore status do they transition to faculty advisors.
	Overview of administrative processes relevant to the pilot (e.g., how transcripts are handled)	Upon receipt of a high school transcript, it is scanned electronically and reviewed by admissions. If GPA is not included, Middlesex requests it from the high school. High school GPA is then input into the Middlesex system. They exempt the student from testing and flag

		them as part of the pilot cohort so that the Institutional Research department will be able to identify them.

As shown in the above tables, the three institutions visited by the study team approached implementing the GPA placement pilot in slightly different ways while sharing similarities in other areas.

- **Approach to current pilot.** Two institutions reported using Pilot Standard A3 and one institution used Pilot Standard A1. Two institutions limited eligibility for placement consideration under the pilot to recent high school graduates while Framingham State University said all students are eligible under its pilot. The role of the advising office and primacy of the pilot vs. ACCUPLACER varied by institution. All students at Holyoke Community College were required to take ACCUPLACER regardless of assessment under the pilot. Only certain majors at Framingham were required to take ACCUPLACER who were included in the pilot. The placement test was recommended but not required at Middlesex Community College (although all students who place into developmental math through the pilot were required to take ACCUPLACER to improve their placement). Respondents at all institutions reported that usually a small share of students each term who were determined college-math ready under the pilot still elect to begin in a developmental or co-requisite remediation math section. It was rare for a student placed by the pilot in developmental math to challenge that placement.
- **Changes to pilot since inception.** Changes described by institutions were typically incremental or minor, although two of the three sites reported previously using Pilot Standard B, and at several institutions, there was some confusion among at least some respondents about which standard was used presently. Access to the pilot in terms of student populations eligible was expanded at all three institutions; for example, Holyoke Community College originally limited eligibility to a handful of local high schools and both Framingham State University and Middlesex Community College restricted it from certain (usually STEM) majors. Respondents at several institutions also described making administrative adjustments such as increasing the admissions or advising office's capacity for handling and storing transcripts.
- **Context.** The math GPA placement pilot was one of several initiatives under oversight by the Department of Higher Education (and others outside DHE's purview) aimed at increasing the number of students who enter and succeed in college-level mathematics courses, and it is clear that the institutions included in the site visits were experimenting with several concurrent efforts. For example, several sites described changes to the curriculum or shortening their developmental math course sequence. Framingham State University was about to experiment with increased student choice in course registration, including within the math department, during the time of the study team's visit; previously, an advisor selected courses.

Fidelity

Overall, staff and faculty report that the pilot mathematics placement policies have been implemented with fidelity. As an analytical note, no one staff or faculty person seemed to be in a position to know whether the pilot policy was implemented with fidelity, since none of the interviewees oversaw the whole assessment and placement process. Two sites reported challenges to implementing the policy with fidelity. At Holyoke Community College, an administrator said that not all advisors, or staff who may provide advising-type services, were fully aware of the GPA placement policy, which may have resulted in uneven application of the pilot. The respondent suggested additional messaging to advisors to ensure that all are aware that the pilot is ongoing would help them provide consistent guidance to students about their math placement. One challenge to fidelity at Middlesex was ensuring that students who did not take math their first semester but were eligible for college math via the pilot were placed into college-level math. At some point during the pilot, administrators at Middlesex added a field into the electronic student record indicating a student's high school GPA so that advisors would have this information available regardless of when the student first enrolled in math at the college. Different respondents from Framingham alternatively reported that the pilot was implemented as intended or that they were not in a position to know.

An analysis of the interviews across respondents from within the same institution yields additional inferences on implementation fidelity. First, at two campuses, some administrators and faculty had a different understanding of the pilot implementation's basic elements, including what pilot standard was currently used (e.g., one respondent thought the campus was using Pilot Standard A1 and another thought A3 was in use). Additionally, at one institution (Holyoke Community College) all students are still required to take ACCUPLACER despite participation in the pilot, and at the other two institutions, ACCUPLACER is still required for a subset of students (e.g., STEM majors). Requiring ACCUPLACER concurrently with application of the GPA placement pilot encourages deviation from placing students through the pilot, although this could be a benefit to the student if they are unprepared for college-level work. Regardless, mandating ACCUPLACER concurrently with assessment through the pilot is a check on the pilot's application. Other challenges to fidelity of the pilot's implementation included some advising staff not being fully aware of the pilot, especially staff drawn from other departments during high-traffic times, and students not being made aware of the pilots in a purposeful way (Holyoke Community College is considering reintroducing notification letters that were used in the first year of the pilot). While not appearing to have an effect on institutions' implementation fidelity, several administrators did not appear to consider the transition from Pilot Standard B (the use of a GPA between 2.4 and 2.69) during the 2014–15 and 2015–16 academic years as a "discontinued pilot," and in some cases, any type change.

Perspectives and Experiences of Faculty Members, Administrators, and Staff

This section documents the perspectives and experiences of the respondents we met with—faculty members, administrators, and staff—in implementing, carrying out, and assessing the pilot. It first presents upper-level reflections from administrators on the effectiveness of using GPA as a criterion for math placement, including benefits, implementation challenges, and concurrent initiatives' spillover

effects. The section then describes respondents' perspectives and experiences specifically on student outcomes observed (e.g., are more students taking and completing college-level math), and concludes with respondents' assessment of the success of the pilot by other criteria and challenges in implementation.

Upper-level reflections on pilot success

A goal of the pilot is to help recent high school graduates advance more quickly to credit-bearing mathematics courses while obtaining the skills needed for college-level work. Respondents were asked to reflect if the pilot has been successful compared to the traditional placement model at meeting these dual measures. Overall, administrators' reactions to this question were positive—virtually everyone we spoke with described the pilot as successful; limitations or challenges described, when encountered, were typically limited in scope or magnitude. As an administrator from Framingham State University described, "I like it because I think that math too often has become a barrier. … We have the potential to take better care of those students." An administrator from Middlesex Community college said the change from the traditional placement model to using GPA as the primary criterion was a monumental change and ultimately contributed to student success, saving time and money. As a math department faculty member at the same campus said, "the pilot rewards those students who can excel, and if we can save a certain percentage of students from getting stuck in the developmental loop and help them be successful, then this is the way to go."

Reflections on observed student outcomes

In exploring the alignment of campuses' math GPA placement pilot experiences with DHE/BHE goals, the evaluation team probed respondents on a series of questions that focused on student outcomes. While a separate component of this study uses quantitative methods to assess impact of the polices on student placement and success, the following administrator, faculty, and staff perspectives both put the quantitative findings in context and give a preliminary self-assessment:

- **Increase in number of students taking and completing college math.** Framingham State University eliminated developmental math courses beginning in Fall 2017; moving forward, students not determined college math ready are enrolled in co-requisite classes that include an extra two hours of lab time. Administrators were very positive about the change for several reasons—all students now immediately begin in college-level math and the university no longer relies on adjunct instructors from a community college to teach these classes. Multiple respondents at Holyoke Community College lauded an increase in course completion rates among students placed by the pilot; among a recent cohort, of students placed by the pilot in college-level math—when ACCUPLACER otherwise indicated a developmental math placement was appropriate—registered a completion rate of 80 percent in the college-level course. Completion rates for all students in college-level math at Holyoke are typically between 65 to 80 percent. An administrator within the math faculty at Middlesex Community College also said completion rates may have increased concurrent with the pilot; other Middlesex respondents were not as sure with the data available.

- **Decrease in time to college-level math.** As mentioned above, Framingham State University eliminated its developmental math courses in Fall 2017, which eliminated the time to college-level math. Reacting more generally to the pilot including the period before the developmental math policy change, a dean at Framingham said the pilot helped advance students through the sequence quicker. "If you look at the data, being placed into remedial math is the kiss of death for college success," they said. "So we cut back on that." Administrators at Holyoke Community College described not only using the pilot to place students directly in college-level math using GPA, but also to advance some students higher up in the developmental math course sequence using GPA (when they either otherwise wouldn't qualify for college-level math or might have reservations at beginning in these courses). Middlesex Community College respondents were not as sure, having not seen data either way.

- **Improved fit of students' initial math placements.** Both within and among institutions, respondents seemed to have the most divergence, or at least variation, in assessing students' improved math placement fit in the wake of the pilot. As a whole, respondents seemed less likely to be sure in their responses to this sub-question. At Middlesex Community College, an administrator said they heard students' initial placements are a better fit, and the school was placing students too low. A colleague within the math department agreed, but said that student success often depends on factors other than placement such as promoting good study and executive functioning skills. The one respondent at Framingham State University who felt they were positioned well enough to have an opinion said placement fit is probably fairly similar from before and after the pilot. Holyoke Community College respondents were split—one administrator said they did not have enough information to answer placement fit. A math faculty member pointed to positive completion rates as a good indicator of improved placement fit: "looking at those who took advantage of the pilot… they're taking courses that seem to fit for them and are being successful there."

- **Is the pilot more successful for different types of students?** As a final sub-question, the study team asked institutions if the pilot has been more successful for certain types of students (e.g., specific majors or demographic backgrounds). At Holyoke Community College, the pilot seems to be more successful for students who put the thought into making an informed decision about what course in which they should begin. This requires students to use the pilot determination as a starting point in a conversation with their advisor, being open to an additional conversation about their optimal placement. At other institutions such as Framingham State University where students within the College of STEM are still required to still take ACCUPLACER to determine placement along the calculus course sequence, the GPA placement pilot's effectiveness appears to be hindered. Making a course selection for this subset of students among college algebra, pre-calculus or calculus isn't easy to determine from high school GPA, an administrator said.

Success of the pilot by other criteria

Beyond students' more rapid advancement to college-level math courses and better fostering the skills needed for college-level work, administrators described the pilot as a success by several other gauges:

- **A better student experience**. Relying less on ACCUPLACER allows for better placement of students who may be poor test takers, a Holyoke Community College administrator said. Students often do not know the importance of the placement test, so they might not take it seriously, described a Middlesex Community College administrator involved with advising. Another advising department administrator from another campus observed the GPA pilot is a more welcoming entrance into the college, which helps student success and community relations. As a math faculty member at one institution observed, the GPA pilot promotes greater student involvement in course selection and a more-informed decision about placement: "I personally think it's helped because it's allowed students to make a smart decision about where they want to be. One of the struggles with any developmental course is students saying, "Why am I here? Why do I need this?"

- **A model for other subjects and potential placement criteria.** In at least one institution, the switch to the GPA math placement pilot encouraged additional thinking about the prospect of expanding the math placement pilot to additional subjects such as English or developing additional placement criteria beyond high school GPA and ACCUPLACER. For example, Middlesex Community College at the time of our visit was exploring placement for courses within the English department using multiple measures such as SAT verbal scores. "The [math GPA] pilot has helped prompt our thinking about different ways to assess a student coming in, in other subjects besides math as well," they said. Another Middlesex administrator said the campus wants to evaluate using SAT math scores for placement.

- **Student outcomes not connected to DHE/BHE goals for the pilot.** Some campuses reported positive student outcomes in areas other than time to college-level courses. A Framingham State University dean said that institution has seen for the last couple of years an increase in the rate of students being retained from their first year to their second year, although it is difficult to attribute it to the math GPA pilot vs. other academic policy changes such as the introduction of co-requisite remediation.

Disadvantages and challenges with pilot standard implementation

While virtually all of the administrators and faculty we met with during the site visits across institutions labeled the math placement pilot a success, respondents described several challenges implementing the policy, and the evaluation team's understanding of other disadvantages emerged. It is important to note that the evaluation team did not explicitly ask respondents about disadvantages in the semi-structured interview protocols used across sites.

Most of the drawbacks related to administrative difficulties such as students not sending transcripts in time to meet with an advisor or students avoiding the ACCUPLACER. Some students initially placed through the assessment test do return with a transcript but many do not. "That's still a battle," an administrator at Middlesex Community College said. Several site visit campuses also described lacking capacity, at least initially, for admissions or advising staff to process and review transcripts, which limited the number of students included in the GPA pilot. A community college math department faculty member said their campus was limited in some ways in the student data that was available for

assessment because there was no common application like four-year institutions. Respondents from multiple campuses also described a challenge of placing students through the pilot who did not take math their first semester, which requires the person overseeing continuing advisement (often a different person than initial advising) to be aware of how high school GPA can be used for math placement. At least one institution built in high school GPA into its student record computer system to account for high school math GPA.

Ensuring that advising or admissions staff were aware of the pilot, especially newer workers or staff drawn from related offices during high-traffic times, was a challenge At least one institution flagged this as a needed area of improvement. Administrators from Holyoke Community College said they are considering re-introducing letters sent out to new, first-time students about the pilots to increase awareness, with the hope that the students (or their parents) can understand how being placed by high school GPA can help them (and emphasizing the importance of sending a transcript). The implications of other policy decisions made by some institutions requiring some or all incoming students to take ACCUPLACER while simultaneously applying the math GPA pilot are discussed in the section on fidelity above.

Impact on Campus-Level Services

A final area explored during the site visits aligns with the research question documenting impacts on campus-level services to new students in developmental math courses because of the GPA placement pilot. As a point of departure in these interviews, the study team first summarized and asked respondents to react to initial findings for each institution from the survey administered in January 2018. This section begins by listing available support services at each of the institutions visited, then moves on to potential impacts of the pilot on campus-level services, and concludes with administrators' brief opinions on the pilot's impact on instructional quality.

Support services available to students in developmental math

All three institutions offered a range of support services for recent high school graduates in developmental math. The extra support most frequently took the form of tutoring—offered by all three institutions—often free to students and either connected to developmental courses or available on-campus in dedicated centers (frequently on a drop-in basis). For example, Holyoke Community College provided a tutoring in a math center as well as separate tutoring in its Center for Academic Support (CAPS); both options were open late and available to all students. Framingham State University had a similar Center for Academic Success and Achievement (CASA), which offered free professional and peer tutoring. In addition to subject matter help, tutors could help plan and prioritize students' workload and build time management and study skills. Across the institutions, most developmental and co-requisite math courses featured built-in lab or supplemental instruction time with instructors or teaching assistants. For example, at Middlesex Community College, every three-credit developmental math course had four contact hours with one hour of practice.

Most institutions provided workshops, sometimes called bootcamps—high-dosage sessions often during the summer or semester breaks focused on helping students quickly develop math proficiency, usually with the intention of allowing students to re-test into a higher-level mathematics course. Holyoke

Community College ran one such course of intensive developmental math review with the aim of boosting students' skills so they can re-test in ACCUPLACER with the goal of scoring a higher course placement in the math sequence. Framingham State University began a mathematics remediation program in fall 2016, which placed students who score under 460 on the SAT math exam in dedicated "foundations" (credit-bearing) math sections that feature weekly meetings with instructors to talk about questions or challenges in certain courses. Other services institutions provided range from self-paced online review modules that could be used to prepare for either ACCUPLACER or to supplement coursework at Holyoke to the construction of modularized, self-paced developmental math courses at Middlesex Community College.

Pilot impacts on campus-level services

The study team asked administrators to describe if there have been any changes to campus-level services as a result of a developmental math pilot since implementation, divided into four broad categories:

1) student support services;

2) student advising practices or processes;

3) course offerings (further broken down by developmental versus college-level math); and,

4) instructional practices (also split by developmental versus college-level math).

To start the conversation, the study team summarized responses the institution provided in the online survey administered January 2018; where respondents had knowledge of each campus-level services area, these earlier survey responses largely were confirmed. In many cases, administrators, faculty, and staff provided additional context. This section of the report summarizes institutions' reactions to changes in each potential service area. In describing potential affects due to the pilot policy, administrators again highlighted the difficulty of disambiguating effects from GPA math placement vs. one of potentially many concurrent initiatives aimed at increasing the number of students who enter and succeed in college-level mathematics courses.

- **Student support services.** Both in the online survey and in follow-up discussion during the site visits, this service area was one of the least cited by respondents as potentially being affected by the pilot policy. At Framingham State University, administrators characterized the two-hour lab included in co-requisite math courses as an example. An instructor and student assistant staff the lab. Framingham administrators also mentioned the STEM Scholars program, described above. At Holyoke Community College, administrators mentioned increased tutoring available and increased preparation available for students to take ACCUPLACER (and students are more-often encouraged to re-take the test). "I think there's greater emphasis on communicating those services right at the beginning [of a student's career]," an administrator said. "There's a high level of awareness around helping students."

- **Student advising practices or processes.** Holyoke Community College noted more of a focus to make students aware of the math placement pilot, including considering the revival of informational letters sent to new students about the pilot's availability and how it could be helpful. Some respondents at Holyoke also expressed a desire to provide more standardized training to staff who help the advising department during periods of high traffic. Holyoke also planned to implement a new on-boarding experience for new students in January 2018, but this initiative was put on hold because of staffing and financial reasons. At Framingham State University, beginning in June 2018, new students will be required to meet with an advisor, which did not happen in the past.

- **Developmental and college-level math course offerings.** Administrators, faculty, and staff from all three institutions visited reported changes to course offerings—in both developmental and college-level math courses—at least in part due to the math placement pilot. For example, Framingham State University eliminated its sole developmental math course offering, MATH 095, General Math. In its place, some college-level sections adopted a co-requisite model with a built-in two-hour lab for students who would have placed in developmental math. A math faculty member said the change came about because of the administration's understanding that co-requisite courses were a priority of DHE. Holyoke Community College changed developmental math courses beginning in spring 2014 to a self-paced modular structure, although this change especially may be more from the college taking part in the Complete College America initiative. At Middlesex Community College, a math department faculty member said that the college has seen increased demand for college-level courses like statistics, which in turn led to more course sections offered and a challenge finding more instructors comfortable teaching statistics vs. developmental math.

- **Instructional practices in developmental and college-level math.** Some of the changes reported by respondents overlap with changes to course offerings; for example, with the shift to co-requisite courses, required labs for some students were added to the course structure. More conceptually, the shift to the pilot may have prompted an examination of some institutions' teaching practices. As an administrator from Framingham State University observed, "You can't just make a change like this and not do something from a pedagogical standpoint. I don't think we're quite there yet, but we are getting there. There are certain faculty members who teach first-year students better than others." A math faculty member from Middlesex Community College said it can be easier to teach higher-level math than developmental math. "Something that's so obvious to us and not obvious to a student takes a different set of skills to be able to explain it," they said. Alternatively, not wanting to change instruction methods was a large part of the Holyoke Community College's math department's willingness to take part in the pilot, a faculty member said. "We didn't want to lower the level of the college-level math class so people could be more successful sooner," the faculty member said.

Pilot impacts on instructional quality

As part of the discussion at each institution on potential impacts of the GPA pilot policy on campus-level services, the study team asked respondents if the pilot affected instructional quality in developmental

math courses. Administrators, faculty, and staff members' responses were limited in this area. Several respondents at Holyoke Community College said they did not feel instructional quality was affected either positively or negatively. One administrator said instructors are always trying to improve their methods and make sure the methods are current, but they were not aware of any specific changes. A member of the math faculty at Holyoke said instructional quality has not changed. At Framingham State University, administrators observed that instructional quality has definitely changed, but the effects are due to that institutions' overhaul of the developmental math curriculum. In 2017, Framingham eliminated developmental-level courses, replacing the classes with co-requisite model in college-level math that included supplemental instruction for students who would have placed in developmental math. Before the transition, developmental-level courses were not taught by Framingham faculty, and instead were led by faculty from a local community college. As a Framingham administrator said, "we ceded complete control to the community colleges… we didn't hire or evaluate the faculty that taught [those classes] here. … [Now] we have more control again."

Points for Consideration

The site visits provided a rich opportunity to explore administrator attitudes and perceptions of the math placement pilot. Several points for consideration emerged that could improve students' math placement experiences and the administrative efficiency of campuses participating in the pilot:

- Consider recommended guidelines for application of the pilot. Currently, BHE specifies three pilot standards (A1, A2, A3). However, there is no related guidance or best practices for how apply the standards, including eligible populations, or interaction with ACCUPLACER, inclusion of other placement criteria, among others. The absence of implementation guidelines may encourage a diffusion of campuses' approaches to pilot implementation that BHE or DHE may consider out of alignment with the goals of the policy.

- Expand strategies for making students aware of the math placement pilot. Benefits to students of taking part in the pilot include a potentially higher math placement (e.g., directly to college-level math), in turn, shortening the required math course sequence and reducing student expenses on tuition. At least several respondents said students often are not aware of the different placement methods, and one campus recommended reviving a notification letter in use for the pilot's first year.

- Encourage administrator training related to math advising, especially across departments and bridging the advising office, admissions, and the math department. Several institutions said not all advisors or administrators involved in advising (especially those who have the ability to set students' math placements) know about the pilot standard or how the pilot stand may be applied.

- Re-emphasize that the pilots are still active. Given that at least some version of the math placement pilots have been in effect since SY14–15 at some institutions, there may be an opportunity for BHE/DHE to highlight the continued option for colleges and universities to use high school GPA for math placement. At least one campus included in the site visits said the continued application of the "pilot" label can be confusing.

Appendix A: Site Visit Protocol

General Information

Interviewee: **Position:**

Institution: **Date/Time:**

Introduction [5 minutes]

- Thank you for taking the time to speak with me today. In fall 2014, the Board of Higher Education initiated a period of experimentation in which campuses were allowed to pilot new mathematics placement criteria for recent high school graduates aimed at helping students advance more quickly to credit-bearing courses while obtaining the skills needed for college-level work.
- DHE staff are now preparing to make a recommendation to the Board of Higher Education in December of 2018 on the use of GPA as a math placement criterion. Information you provide will not affect funding or personnel decisions at your institution. The findings of this interview will be summarized in a final report intended to inform the ongoing implementation of these strategies as well as future policy decisions by the BHE and DHE. This interview is not part of an audit or compliance review.
- We recognize that the degree and scope of the pilot programs' implementation is diverse across campuses. The purpose of this interview is to better understand differences in implementation of math pilot programs across campuses.
- We will take notes during these interviews. Information you provide is never associated with your name or the name of any respondent in any report. We will not directly share what you tell us with supervisors, colleagues, or DHE. When we write our reports and discuss the study findings, information from all informants is compiled and presented so that no one person is identified. Only data aggregated at the institution level will be viewed by people outside the study team, but—again—your name will not be used. We will be sharing the findings from this study with DHE as well as preparing a final report that may be shared with other institutions or released publicly. Since there are a limited number of sites being interviewed, information will be presented in our reports that may enable a reader to infer the identity of the information source. However, in the event that you would prefer we stop taking notes for any portion of a question response, please let me know and we will be happy to do so.
- Just to confirm: we're scheduled from ____ to ____ today – does that still work for you?
- (Ask for permission to use recorder before starting the recorder and after.)

INTERVIEW QUESTIONS

1. What is your role at [institution] (e.g., director of advising, developmental education coordinator, etc.)? How long have you held this position?

2. Based on data submitted by your institution to DHE through HEIRS, and responses your institution provided to a brief survey about this initiative, our understanding of your institution's pilot program(s) is:

    - Type of pilot(s) implemented:
    - Number/percent of new students placed by pilot, by year:
    - Student populations eligible for placement under the pilot program:
    - Changes made to the pilot:
    - Discontinued pilot(s):

    Is that an accurate and complete description of the basic features of your pilot program, or do you have clarifications or additions to this general description?

3. From your survey responses and this interview we understand the standards you use for determining college math readiness. Can you tell us more about how these standards factor into the placement of students in developmental or college-level math courses?
    a. What role do academic advisors play in the math placement process?
    b. Are some students who are deemed to be 'college math ready' placed in developmental mathematics courses?
        i. If yes, why?
        ii. What is the role of ACCUPLACER (or other placement criteria) in this process?
        iii. What is the role of the placement pilot in this process?
        iv. What is the role of student choice in the placement process?
    c. Are some students who initially place into developmental mathematics courses encouraged to seek some other placement method into college-level math (e.g., students with a GPA below the pilot cut off encouraged to take ACCUPLACER)? If yes, why and in what situations?
    d. Have you noticed a change (or have instructors/staff reported observations to you) in the preparation level of students placed in college-level math since the introduction of the pilot?

4. A goal of the pilot is to help recent high school graduates advance more quickly to credit-bearing mathematics courses while obtaining the skills needed for college-level work. By this measure, has the pilot been successful? What are your reflections on the effectiveness of the pilot strategy compared to the traditional placement model?

    Probe:
    a) Are more students taking and completing more credit-bearing mathematics courses?
    b) Are students advancing more quickly to credit-bearing mathematics courses?
    c) Are students' initial placements generally a better fit now?
    d) Is the pilot more successful for certain types of students (e.g., specific majors or demographic backgrounds)?

e) Has the pilot policy been successful by any other criteria (those beyond the goals directly stated by BHE/DHE)?
f) What were your expectations for the pilot, and where these expectations met? If not, how so?

5. What modifications were made to the pilot standard(s) to support its success, and ultimately, improved student outcomes?

   Probe:
   a. Were changes made to the placement policy at your institution (e.g., eligible populations; course offerings covered by the pilot)
   b. Were changes made to administrative processes at your institution (e.g., requiring or recommending that students meet with an advisor or counselor to discuss placement recommended by the pilot vs. ACCUPLACER)
   c. In what ways might pilot placement criteria or administrative processes need to be adapted to support the continued implementation of the pilot?

6. From FY 14 to now, to what degree were pilot placement policies implemented with fidelity (i.e., as intended) at your institution?

   Probe:
   a. Has the fidelity of policy implementation changed over time?
   b. What steps were taken to ensure that the policies were implemented with fidelity?
   c. How could the fidelity of policy implementation be improved?

7. My understanding is that the following support services are available to recent high school graduates placed in <u>developmental math</u> at your institution:

   Is that an accurate and complete description of the support services you offer, or is there something else you would like to add?

8. In response to our survey, your campus indicated that the pilots had the following impacts on campus-level services (including the quality of instruction, student advising and support services, etc.):
   a. Could you please provide more detail about these impacts? Were these impacts viewed as positive? In what ways and to what extent?
   b. Do you think there may have been changes to campus-level services potentially because of the pilot that we have not mentioned? [include as examples the areas checked “no” in the survey]

   How have the math placement pilot(s) at your institution affected instructional quality in <u>developmental</u> math courses?

9. Are there any other initiatives happening at your institution that have contributed to changes in students' math placement, student outcomes in mathematics, mathematics course offerings, or math pathways? If so, could you briefly describe these initiatives/efforts? In what ways and to what extent has the pilot worked in concert with these other initiatives?

10. Is there anything else you would like to add?

Developmental Mathematics Education Evaluation

Report on Initial Qualitative Findings

March 19, 2018

UMASS DONAHUE INSTITUTE
Applied Research & Program Evaluation

Developmental Mathematics Education Evaluation

Prepared by the UMass Donahue Institute's
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Appendix A – Survey Instrument

Appendix B – Approach to Math Placement, Comparison by Institution

Introduction

This brief summarizes high-level findings from an open-ended, internet-based survey. This survey is one component of the Developmental Math Evaluation conducted by the UMass Donahue Institute (UMDI) for the Massachusetts Department of Higher Education (DHE). A mixed methods approach combining qualitative and quantitative methods is being used to assess the implementation and impact of changes to mathematics developmental education placement policies at community colleges, state universities, and University of Massachusetts campuses.

Quantitative methods are being used to assess impact of the polices on student placement and success, while qualitative methods—including the open-ended survey and forthcoming interviews with faculty and staff—will be used to and describe changes to service provision, stakeholder experiences and perspectives, and possible variation in implementation. This brief is the first of two deliverables summarizing results of qualitative data collection and analysis. Separate reports are prepared for the quantitative-focused evaluation components.). All findings will be incorporated into the final evaluation report due October 2018.

The Developmental Math Pilot Program has completed three years of a pilot phase of experimentation and innovation (SY14–15, SY15–16 and SY16–17), and campuses were offered the option to continue or revise their pilot implementation in fall 2015. This revised policy—and its impact on student outcomes—is the primary focus of this evaluation.

The open-ended survey that is the focus of this brief directly addresses the following research question (one of four questions comprising the overall evaluation):

> RQ2: Did implementation of the BHE policies have impact on provision of campus-level services (including the quality of instruction, student advising and support services, etc.) to recent high school graduates enrolled in mathematics developmental education courses?

To address this question, the survey results address the following topics of inquiry:

- Developmental math pilot implementation, including current pilot implementation strategy and changes in strategy since initiation of the pilot (and reasons for those changes)
- Changes in campus-level services since pilot developmental education strategies were implemented

The remainder of this brief details the survey methodology, explores results from the above topics of inquiry, and presents several points for discussion.

Survey Methodology

UMDI developed the survey with input and review from DHE and administered it in January 2018 via the online survey platform Qualtrics. The study team in consultation with DHE exclusively invited participation from institutions determined to be actively implementing at least one of the Developmental Math Pilot Program standards in fall 2017. Colleges or universities reporting in HEIRS at least a subset of students determined college-math ready through one or multiple pilot standards were targeted for inclusion. DHE reviewed the initial list of schools and further refined it based on follow-up correspondence with key college/university staff. As an additional check, the first survey question asked if the institution was currently conducting any math placement pilot programs for AY 2017–18; although no college or university checked "no," doing so would have precluded the respondent from completing the survey. Thus, survey results only reflect institutions taking part in at least one math placement pilot as of January 2018, and colleges/universities that used a pilot standard in the past but returned exclusively to previous placement criteria are not included in the survey or this brief.

Additionally, the 16 institutions that participated in the survey represent the study team's best understanding of colleges and universities currently using at least one pilot standard as of January 2018. The full list is as follows:

Community Colleges
Berkshire Community College
Bristol Community College
Bunker Hill Community College
Cape Cod Community College
Greenfield Community College
Holyoke Community College
Middlesex Community College
Mt. Wachusett Community College
North Shore Community College
Northern Essex Community College
Quinsigamond Community College
Springfield Technical Community College

State Universities
Fitchburg State University
Framingham State University
Salem State University
Westfield State University

The study team sent customized survey links to each institution's president, copying the Institutional Research (IR) director and chief academic officer (CAO). Respondents were encouraged to collaborate with others such as the director of assessment, director of advising, and/or mathematics department chair who had been involved in the pilot initiative implementation, placement criteria, and application in practice. Each college or university was given about three weeks to complete the survey. All sites completed the survey within the requested timeframe.

The survey began with a prompt asking respondents to think of pilot programs related to the criteria used to place entering students who are recent high school graduates into their first college

mathematics course (developmental and/or college-level). It was comprised of 22 questions, a mix of open- and close-ended items, and certain questions repeated depending on the number of pilots reported. Open-ended items were structured in the survey platform to facilitate shorter (paragraph-length) responses, although no actual response length constraints were imposed. A copy of the survey, including prompts and questions, is included in Appendix A.

Findings

This section is divided into two segments: 1) institutions' pilot implementation, including an overview of pilot standards in use, changes over time, and respondents' brief reflections on issues implementing the pilots; and 2) changes in campus-level services as a result of the pilots, including available support services and the most common types of changes in services institutions experienced.

Key finding: institutions reported a variety of approaches to implementing the developmental math pilot standards.

- ✓ Of the 16 institutions identified as currently participating in a math placement pilot, nine used Pilot Standard A1, three used Pilot Standard A2, and four used Pilot Standard A3. No institution reported using more than one pilot standard, although most institutions described additional or separate placement criteria in use such as ACCUPLACER, enrollment in certain majors, or college entrance exam scores.

- ✓ Most institutions—12 of 16—reported making at least one change to a pilot math placement standard currently in use. Changes ranged from criteria used for placement to eligible populations as well as other changes.

- ✓ Challenges to implementing the pilots described by survey respondents generally fell in three categories: 1) administrative challenges such as difficulty converting student GPAs across different scales; 2) faculty objections to the pilots such as a belief the pilots set some students up for failure; and 3) student challenges such as being "math phobic" and not enrolling in a college-level mathematics course despite placement from a pilot standard.

- ✓ Three institutions reported discontinuing math placement pilot programs implemented in prior years.

Key finding: every institution described at least some level of support services available to recent high school graduates, and many institutions reported changes to campus-level services as a result of a math placement pilot.

- ✓ All but one institution described changes to some aspect of campus-level services because of a pilot.

- ✓ Student advising practices was an area of campus-level services most-frequently mentioned by survey respondents as changing because of the pilots. Respondents emphasized the need for additional conversations with students about students' math course choices and possible implications for their different placement options.

- ✓ Changes to developmental math course offerings, college-level gateway math course offerings, and instructional practices in developmental math were also areas prominently identified by survey respondents.

Developmental Math Pilot Implementation

Given the broad flexibility afforded to colleges and universities in adopting the pilots, institutions reported a variety of approaches in how they structured and applied pilot standards, and no two institutions reported implementing the pilot standards in exactly the same way. However, some institutions were more alike than dissimilar, and several trends emerged. Table 1 summarizes each institution's overall approach to math placement, including the current pilot standard in use, when it was adopted, the student population to which the pilot applies, other placement criteria, and whether the institution enacted changes to a pilot.

Table 1

Approach to Math Placement, as of January 2018

Institution	Current pilot standard	Term/year adopted	Eligible population	Other placement criteria[1]	Changes to any pilot standard?[2]	Discontinuation of any pilot?[3]
Berkshire Community College	A2	Fall 2014	Graduated high school within the last three years	ACCUPLACER	Yes	No
Bristol Community College	A1	Fall 2014	Students from any Massachusetts high school		Yes, multiple	No
Bunker Hill Community College	A1	Fall 2016	Current students and recent graduates of any Massachusetts high school		Yes, multiple	No
Cape Cod Community College	A1	Fall 2015	Recent high school graduates (Students who have graduated within the past three years)		Yes	No
Fitchburg State University	A1	Fall 2015	Students who require as their first pathway math course either Applied Statistics, Business Statistics or Intro to Functions		Yes, multiple	No
Framingham State University	A3	Fall 2015	All students	ACCUPLACER	No	No
Greenfield Community College	A2	Fall 2014	Recent high school graduates; they must also place out of developmental English as determined by the Accuplacer	ACCUPLACER	Yes	No
Holyoke Community College	A3	Fall 2014	HS graduates who graduated 3 years or less from placement	Placement test, AP credit, transfer credit	Yes, multiple	No
Middlesex Community College	A1	Fall 2014	New students, graduated in the past three years.		Yes	No
Mt. Wachusett Community College	A1	Fall 2014	All new students who have graduated high school in the three years prior to their admission	ACCUPLACER, conversation with advisor	Yes, multiple	No
North Shore Community College	A1	Fall 2014	Student earn Mathematics Proficiency, as defined by NSCC academic policy.	Communications proficiency; GPA 1; GED, PSAT, ACT, SAT scores	No	Yes
Northern Essex Community College	A1	Spring 2015	Students who graduated high school in 2014 and after.	ACCUPLACER	Yes	No
Quinsigamond Community College	A3	Fall 2016	Incoming first-time freshman; graduated in the last three years from high school		No	Yes

Salem State University	A3	Fall 2014	Incoming first-time, full time freshmen	SAT scores	Yes, multiple	No
Springfield Technical Community College	A2	Fall 2016	Any incoming student without transferable college-level math credit or developmental-level math credit	Placement test	No	Yes
Westfield State University	A1	Fall 2014	All students	Matriculation as a business major; placement test	Yes	No

Source: UMDI web survey administered January 2018; only institutions using at least one pilot standard as of January 2018 are shown

[1] Additional or alternative placement criteria reported for at least some students in some situations

[2] Changes since adoption of an existing pilot standard

[3] Discontinuation of at least one pilot reported since period of experimentation began in Fall 2014

Pilot standards – core elements

Of the 16 institutions identified as currently participating in a math placement pilot, nine used Pilot Standard A1, three used Pilot Standard A2, and four used Pilot Standard A3, as defined in Table 2. No institution reported using more than one pilot standard in the survey as defined by the Developmental Math Pilot Program. Interestingly, despite not reporting more than one GPA-related pilot standard in use for the current academic year, two schools—Westfield State University and North Shore Community College—indicated that they use multiple standards to place students, including non-GPA criteria, which are described below under "additional placement criteria". This indicates that the individual(s) who completed the survey may have considered criteria outside the GPA-related pilot standards to be part of the Developmental Math Pilot Program.

Table 2
Pilot Standard Definitions

New Pilot Standard	Definition
A1	Student determined to be college ready based on a high school GPA of 2.7 or above.
A2	Student determined to be college ready based on a high school GPA of 2.7 and a "B" or higher in Algebra II.
A3	Student determined to be college ready based on a high school GPA of 2.7 and four years of high school math.

Most institutions—nine total—first adopted the respective pilot standard currently in use beginning in fall 2014, with additional institutions doing so in fall 2015 and fall 2016. Institutions generally applied the pilot standards to new students, most-typically defined as graduating high school within three years, although two institutions—Framingham State University and Westfield State University—indicated that the pilot standards are applied to all students. Springfield Technical Community College indicated that the pilot standard applies to any incoming student without transferable math credits. Salem State University and Quinsigamond Community College require students placed by the pilot standard to be freshmen. Institutions' more-novel restrictions on the student population for which the pilots apply include Fitchburg State University (which requires eligible students to also place out of developmental English, as determined by ACCUPLACER), and Salem State University (which requires students to be enrolled full time).

Additional placement criteria

Most institutions offered additional placement criteria in concert with the pilot standards; the most common alternative or additional placement standard explicitly mentioned by survey respondents was ACCUPLACER (five schools). ACCUPLACER could be offered in addition to the pilot standard to give students the opportunity to place at a higher level, such as at Northern Essex Community College. At least four institutions require ACCUPLACER administration in some manner. For example, Quinsigamond Community College requires all incoming students to take ACCUPLACER, where the math placement

decision appears to be more holistic with an advisor working with the student considering both criteria. Springfield Technical Community College described a similar process of mandating ACCUPLACER for all students without transfer credit, but students could opt-into a higher math placement based on the pilot through consultation with an advisor. At Framingham State University, only a segment of students—those wanting to take a course higher than college algebra (e.g., pre-calculus or calculus I)—are required to take ACCUPLACER regardless of GPA pilot status. Likewise, Mount Wachusett Community College requires students on a STEM track (i.e., in a major requiring calculus) to take ACCUPLACER and have a conversation with an advisor about whether they are a good candidate to be placed directly into college-level math. One institution, Salem State University, indicated that it uses the mathematics portion of the SAT for placement for at least some students (to qualify for college-level math, students need to have scored 500 on the old SAT mathematics portion or 530 on the new SAT mathematics portion).

As mentioned above, Westfield State University and North Shore Community College indicated that they are implementing multiple pilots apparently based on other (non-GPA) criteria. No institution indicated that they are currently implementing more than one pilot standard as defined by the Developmental Math Pilot Program, which is the focus of this study. In practice, the criteria these schools marked as separate pilots appear similar to the additional criteria described above for the schools describing only one pilot, but may imply a special status or that the criteria are applied separately (and not in concert with the GPA pilots) to a subset of students rather than in addition to the GPA-based standards. A summary of the criteria for the two institutions' self-described additional pilots for math placement are as follows:

- Westfield State University – matriculation as a business major; separately, placement test administered during the first week of class
- North Shore Community College – college entrance examination scores (GED, PSAT, ACT, SAT)

The exact delineation and flow of students through institutions' assessment structure(s) is not always known due to limitations of the survey and respondents' answers.

Changes to pilot standards

Most institutions—12 of 16—reported making at least one change of a pilot math placement standard currently in use, also shown in Table 1 above. Half of the institutions reporting changes to their placement standards described multiple types of changes. Potential changes were grouped in three categories: 1) changes to the criteria used for placement; 2) changes to the student population(s) eligible for placement under the pilot; and 3) other changes. Table 3 below shows each piloting institution, and the changes to the pilot implementation reported through the survey.

Table 3

Institutions' Changes to Pilot Standards

Institution	Have there been changes in any of the following as a result of your institution's implementation of a developmental math pilot?		
	Changes to criteria used for placement	Changes to student population(s) eligible for pilot	Other changes
Berkshire Community College	–	✓	–
Bristol Community College	✓	✓	✓
Bunker Hill Community College	✓	✓	✓
Cape Cod Community College	–	–	✓
Fitchburg State University	–	✓	✓
Framingham State University	–	–	–
Greenfield Community College	–	✓	–
Holyoke Community College	✓	–	✓
Middlesex Community College	–	✓	–
Mt. Wachusett Community College	✓	✓	–
North Shore Community College	–	–	–
Northern Essex Community College	✓	–	–
Quinsigamond Community College	–	–	–
Salem State University	✓	✓	–
Springfield Technical Community College	–	–	–
Westfield State University	–	✓	–

Source: UMDI web survey administered January 2018

Changes to criteria used for placement reported by institutions varied based on the pilot standard employed and in some cases indicated the discontinuation of pilots used previously. For example, Middlesex Community College originally required four years of high school math as part of the pilot, which was later removed as a pilot placement criterion. Changes to ACCUPLACER are also included in this subcategory, as in Mount Wachusett Community College, which removed the ACCUPLACER requirement for non-STEM students.

Changes to the student population eligible for a pilot mostly centered on expanding which high schools from which students graduated would be considered. Salem State University, for example, originally applied its pilot to only two orientation groups (approximately 325 first-time, full-time students) the pilot's first year in 2014 but expanded the application of the pilot criteria the following year to all incoming first-time, full-time students. A slightly different type of change was reported by Berkshire Community College, which expanded the pilot from students who graduated high school within the last two years to within the last three years. Also included in this category are schools which expanded the

college-level courses in which students were allowed to be placed by pilots. For example, Fitchburg State University originally only allowed students placed by the pilot standard to participate in applied statistics course in fall 2015, but later expanded that list to include three course as of spring 2018.

Other changes mostly pertained to administrative details related to the application of the pilot standards. For example, at Mount Wachusett Community College administrators shifted from requiring a final high school transcript for pilot placement to requiring a transcript from the student's first semester of their senior year because high school guidance counselors often were slow to send complete high school transcripts over the summer. Cape Cod Community College removed the ACCUPLACER re-test fee, expanded workshops, and added online tutoring options (students may retest in certain situations); the college also changed its policy to require students to enroll in a mathematics course their first semester and continuously in subsequent semesters until meeting program requirements.

Challenges in applying pilot criteria

The challenges in applying the pilot criteria reported by survey respondents' were generally grouped in the following categories: 1) administrative challenges; 2) faculty objections; and 3) student-related challenges. Most of the challenges described by survey respondents were administrative; common concerns included difficulty obtaining transcripts for some students, the general inconsistency in calculating GPAs (i.e., different GPA scales) across high schools, and some high schools not reporting full GPAs. As one respondent said, "it was incredibly time-consuming to calculate student GPAs based on only core courses – to go full scare, [the] decision was made to use GPAs as reported." Another administrative challenge reported by multiple institutions was needing to modify their information technology systems to track placements because of the pilot standard. At one institution there weren't enough seats in a cluster of introductory college-level courses, and this was attributed to more students being eligible to participate in college-level mathematics because of the placement pilot.

Several institutions described faculty resistance to the pilots. Respondents reported there being a perception among faculty that students placed by this method could be less likely to be prepared for college-level mathematics courses. One respondent noted, "Math faculty are concerned that students are being placed in [college-level mathematics] that have low ACCUPLACER scores, and this sets up the student for failure." Another respondent indicated that some students really should take developmental math but still elect to begin in a college-level course because of the pilot and are not fully prepared. A related question that was reported by several institutions was whether to count college-level math placement as fulfilling mathematics prerequisites for some science courses.

Conversely, respondents indicated that some students placed through one of the pilot standards are resistant to enrolling in a college-level mathematics course because they may not be as confident about their math abilities. "Many of these students are not willing to go directly into college-level math," one respondent said. Also, a survey respondent from one school reported that some students do not take any type of mathematics course their first semester, making it difficult to enforce placement in

subsequent semesters. At one institution, students frequently register for their first mathematics course before the school receives their high school transcript.

Other challenges identified by survey respondents included difficulty promoting awareness by both faculty and students about the pilot standards and faculty and staff from the same institution issuing at times conflicting information about placement rules. Several respondents identified developing criteria for GED, HiSet, and home-schooled students, who are not included in the current pilot.

Consistency in student placement

The survey was not designed to fully address research question 4, which asks if the placement pilots were implemented with fidelity. However, survey respondents were asked about the likelihood of students with similar academic backgrounds (i.e., high school GPA, placement score, or high school math-taking record) having different placements. Responses to this question offer some insight into the extent to which the pilots were implemented with fidelity, and are summarized below.

By far, the most-often reported reason for students with similar academic backgrounds realizing different math placements was if they elected to take the ACCUPLACER test. "The GPA placement [standard] allows students to take entry-level college mathematics, and ACCUPLACER allows for a higher level placement," one responded noted. Alternatively, it was reported that some students who are determined to by college math ready by a pilot standard perform poorly on ACCUPLACER, which leads them to consider taking a developmental mathematics course. Some respondents also noted that it is a challenge to place appropriately students who identify as being "math phobic," a group an administrator estimated constituting 10 percent of the student population at one site. Respondents noted that these students frequently opt out of college-level mathematics despite qualifying for placement in to college-level mathematics through the pilot. In at least one institution, certain majors (nursing, chemistry, biology, computer science, mathematics, environmental and earth science, and game design) are required to be placed using ACCUPLACER. Differences in SAT scores at one institution were another possible reason students with similar academic backgrounds would be placed differently. Ultimately, at some institutions, students must elect to take part in the pilot, over which administrators said they had little control.

Discontinued pilots

As shown above in Table 1, three institutions reported discontinuing any math placement pilot program implemented in prior years. (It is also possible that discontinued pilots for some institutions may have been described in the changes to pilots section above.) The discontinued pilots for each of the three institutions are summarized below:

- North Shore Community College reported beginning the pilot by implementing new pilot standard B, as defined by DHE. Through a review of this policy, the college found that students placed into college-level mathematics through the application of this standard were

inadequately prepared for college-level mathematics courses. The college discontinued the use of this placement standard in fall 2016.

- Quinsigamond Community College reported a first pilot program during AY 2014–15 that involved QCC staff assigning first-time, degree-seeking freshmen a math code corresponding to the number of college preparatory high school mathematics courses they completed. Students receiving a code of three or four and an overall high school GPA of 2.4 or higher were considered candidates for the math pilot. All students were expected to take ACCUPLACER to identify where they would have placed according to established placement methods.
- Springfield Technical Community College reported using additional criteria connected to recent high school graduation, cumulative high school GPA of 2.5 or higher, or enrollment in the general studies program, but the criteria were discontinued and replaced because very few students were found eligible.

In addition to the math placement pilot described for each institution as reported in the survey, the study team compiled a list of the pilot standard(s) institutions have used in previous years as reported to DHE through HEIRS. A year-by-year comparison of each institution's pilot type is shown in Table 4 below.

Table 4

Approach to Math Placement, by Year

Institution	Fall 2014[1]	Fall 2015[1]	Fall 2016[1]	Fall 2017[1]	Jan. 2018[2]
Berkshire Community College	A	A	A2	A2	A2
Bristol Community College	A, B	A, B	A1, A2	A1, A2	A1
Bunker Hill Community College	n.a.	n.a.	A1	A1	A1
Cape Cod Community College	n.a.	A	A1	A1	A1
Fitchburg State University	n.a.	n.a.	A1	A1	A1
Framingham State University	A, B	A, B	A3	A3	A3
Greenfield Community College	A	A	A2	A2	A2
Holyoke Community College	A, B	A, B	A2	A2	A3
Middlesex Community College	A, B	A	A1	A1	A1
Mt. Wachusett Community College	A	A	A1	A1	A1
North Shore Community College	A, B	A, B	A1	A1	A1
Northern Essex Community College	A	A	A1	A1	A1
Quinsigamond Community College	A	A	A3	A3	A3
Salem State University	A	A	A3	A1	A3
Springfield Technical Community College	n.a.	n.a.	A2	A2	A2
Westfield State University	A	A	A1	A1	A1

Note: only institutions using at least one pilot standard as of January 2018 are shown

[1] Compiled from HEIRS data

[2] As reported to UMDI in web-based survey administered January 2018

The research team also compiled data for each piloting campus on the share of students placed through any pilot standard (as reported to DHE through HEIRS) versus the share of students placed via ACCUPLACER or any other standard. Please see Appendix B for this information matched with the pilot type and other placement criteria campuses reported in the survey.

Campus-Level Services

Roughly a third of the items included in the survey were related to campus-level services and supports, and changes that may have been made to these services and supports as a result of the pilot. This section begins with a summary of institutions' open-ended response to the question of which support services are available to recent high school graduates placed in developmental math, then provides an overview of campuses' responses to changes in these services as a result of a developmental math pilot. This section concludes with respondents' reflections whether the math placement pilots contributed to improvement in instructional quality in developmental mathematics courses.

Available support services for developmental math students

Every institution that reported offering developmental math courses described at least some level of support services available to recent high school graduates placed in these courses. Westfield State University was the exception; the respondent(s) indicated that Westfield State does not offer non-credit developmental math courses but instead uses a co-requisite extended time section model for academic support, and any student in this section may access free tutoring. Most schools offer tutoring for students in developmental math, usually offered at a dedicated center on campus, online, and/or with peers. Many campuses provide some level of free tutoring. At least six schools provided some type of workshop or "bootcamp," that is, high-dosage sessions often during the summer or semester breaks focused on helping students quickly develop math proficiency, usually with the intention of allowing students to re-test into a higher-level mathematics course. Other available support services range from an extra hour of class time built into the course per week for practice or in-class practice, peer supplemental instructors, dedicated workspaces on campus for group work or study sessions, and a purposeful five-day a week course meeting format.

Changes in services

The survey asked administrators to describe if there have been any changes to campus-level services as a result of a developmental math pilot since implementation, divided into four broad categories: 1) student support services; 2) student advising practices or processes; 3) course offerings (further broken down by developmental versus college-level math); and, 4) instructional practices (also split by developmental versus college-level math). Additionally, respondents were asked to reflect on any other programs or practices aimed at supporting students to successfully complete their first college-level mathematics course. Institutions reporting changes to each campus-level service category are shown in Table 5.

Table 5

Changes in Campus-Level Services

Institution	Have there been changes in any of the following as a result of your institution's implementation of a developmental math pilot?						
	Student support services (in developmental math)	Student advising practices or processes	Developmental math course offerings	College-level gateway math course offerings	Instructional practices (in developmental math)	Instructional practices (in college-level gateway math)	Other programs or practices[1]
Berkshire Community College	✓	✓	✓	✓	✓	✓	✓
Bristol Community College	–	✓	–	–	–	–	–
Bunker Hill Community College	✓	✓	✓	✓	✓	✓	✓
Cape Cod Community College	✓	✓	✓	–	✓	–	✓
Fitchburg State University	✓	–	–	✓	✓	✓	–
Framingham State University	✓	✓	✓	✓	✓	✓	✓
Greenfield Community College	–	✓	–	–	–	–	–
Holyoke Community College	–	✓	✓	✓	–	–	–
Middlesex Community College	–	–	✓	✓	–	–	–
Mt. Wachusett Community College	✓	✓	✓	✓	✓	✓	✓
North Shore Community College	–	✓	✓	–	–	–	✓
Northern Essex Community College	–	✓	–	–	–	–	–
Quinsigamond Community College	–	✓	✓	✓	✓	✓	–

Salem State University	–	–	–	–	✓	✓	✓
Springfield Technical Community College	–	✓	–	–	–	–	–
Westfield State University	–	–	–	–	–	–	–

Source: UMDI web survey administered January 2018

[1] Other programs or practices aimed at supporting students successfully completing their first college-level mathematics course.

All but one of the institutions included in the survey described changes to at least one campus-level service category. Three institutions reported changes to only one category, but most schools indicated changes across multiple categories. Respondents from Berkshire Community College, Framingham State University, and Mount Wachusett Community College reported changes in all seven sub-areas of campus-level services. The most institutions (12) reported changes in student advising practices or processes followed by developmental math course offerings (9), college-level gateway math course offerings (8), and instructional practices in developmental math (8). The smallest share of institutions (6) reported changes to student support services because of the pilots. In each category for this an institution marked "yes," they were prompted to briefly describe the changes and the reason for those changes. Much of the rest of this section explores schools' responses in these areas; analysis is presented in the same order of columns above in Table 3.

Student support services: Six institutions affirmatively for changes to this category. Multiple campuses reported adding tutoring, workshops, or online resources to facilitate student success. Campus changes to student support services ranged from adding tutoring or online math resources options to requiring students who do not meet the minimum math placement pilot criteria to take a two-hour-per-week lab staffed by an instructor and an assistant to work on co-requisite skills.

Student advising practices or processes: Changes in advising reported by survey respondents centered on additional conversations with students about their math choices and possible implications for the different placement options. "Advisors now have more focused conversations with students about their math choices (GPA placement vs. ACCUPLACER) and how those placements would (or would not) work for their program of interest," one respondent indicated. Another institution described increasing outreach efforts targeted at students to let them know about the alternative math placement option. Conversely, at least one institution, Mount Wachusett Community College, streamlined required advising conversations after implementing its pilot—effective spring 2017, only students entering calculus in the STEM math track are required to meet with an advisor to discuss whether to go directly into college math as allowed by the pilot (previously, all students did so). At Bunker Hill Community College, staff worked with all academic departments in AY 2016–17 to comprehensively catalogue math prerequisites for STEM and non-STEM pathways to better coordinate with advisors and ultimately provide better-targeted information to students on appropriate math placement courses to take the pilot.

Developmental math course offerings: The most popular change to developmental math course offerings cited by survey respondents (at four institutions) was the addition of co-requisite courses that combine elements of developmental and college-level curriculum in a single course. Other changes included removing the lowest developmental math course from the curriculum (described by at least two schools), and delineating or enhancing students pathways for advancing through math courses. For example, North Shore Community College added STEM and non-STEM pathways giving students different options for eventually progressing to college-level math.

Instructional practices in developmental math course offerings: As mentioned above, multiple institutions added co-requisite course offerings and addressed the sequencing of courses due to the pilots. Fitchburg State University described implementing a 1- or 2-semester developmental math sequence with a maximum student-to-instructor ratio of 13-to-1. Bunker Hill Community College detailed a multi-faceted process that began in summer 2015 with regular, department-wide professional development for all full-and part-time faculty in the math department on developmental and co-requisite math instructional practices (grounded in the theories of Growth Mindset and Productive Persistence). The following year, design teams redesigned the pre-statistics and STEM clusters using a more integrated pedagogical approach. The college further expanded professional development a year later.

Other programs or practices aimed at supporting students to successfully complete their first college-level math course: survey respondents' descriptions of other programs or practices for college-level math courses were limited and did not concentrate on any one common theme. Bunker Hill Community College described a curricular alignment effort with five Massachusetts high schools, and a curriculum alignment team focused on better-preparing potential students for college-level math. Similarly, Mount Wachusett Community College has been teaching developmental math in some high schools to augment college-math preparedness. Quinsigamond Community College said it standardized its MAT 100 college algebra course due to an increasing number of underprepared students so that all students in this course are studying the same objectives at the same pace and degree of difficulty, allowing facilitating improvements to the delivery of support services.

Improvement in instructional quality

As a final question, the survey asked respondents if they believed the math placement pilots at their institution have contributed to improvement in instructional quality in developmental math courses. Respondents generally postulated some connection between the pilots and instructional quality in these courses, and indicated that the ability to isolate effects specifically to the pilots (versus other concurrent initiatives) was limited and/or that not enough data exists to make a determination. One respondent was more pessimistic: "The math pilot has redistributed the problem of students who lack math skills. It does not address inadequate preparation for college math." Another respondent was more positive, commenting that there is now greater instructional consistency across all developmental and co-requisite courses that allows math faculty to engage in regular, meaningful assessment and reflective practice. Others simply said there is not yet enough data.

Points for Discussion

As the developmental math evaluation progresses, including site visits to three campuses as part of the qualitative component of the study, several topics raised by survey respondents could be especially informative to pursue further:

- Interaction between changes possibly resulting from the math placement pilots versus competing initiatives on campus. Several campuses across several topics in the survey described observing changes to course offerings or pathways, but it was difficult to isolate the degree to which the math placement pilots may be responsible versus other ongoing grants and programs.
- Whether the perception held by some survey respondents that the math placement pilots set up some students for failure is supported by on-campus interviews with math department staff, and also, quantitative data analysis.
- How specifically are some students encouraged to "opt in" (or out) of the math placement pilots, and especially, the interplay between students conceding math placement through a pilot versus taking the added step of completing an ACCUPLACER exam for the purpose of a higher (potential) placement (and vice-versa, deciding it's beneficial or at least preferable to regress to starting in developmental math despite a math placement pilot determination for Glossary of Terms

Appendix A

Developmental Math Pilot Survey

In fall 2014, the Board of Higher Education initiated a period of experimentation in which campuses were allowed to pilot new mathematics placement criteria for recent high school graduates. On behalf of the Massachusetts Department of Higher Education, the UMass Donahue Institute's Applied Research and Evaluation Group is conducting a study of implementation and outcomes of this initiative.

One component of this study is a survey of campuses to learn more about pilot programs currently being implemented, as well as changes that have may have taken place over time, and institutions' reflections on the pilot initiative as a whole. Your input is critical to the success of the study in informing future planning in relation to developmental math education policies.

Responses to this survey should represent the perspectives of your institution. As such, in completing this survey, we recommend that you collaborate with others at your institution who have been involved in or are otherwise knowledgeable of the pilot initiative implementation, placement criteria, and application in practice. Some recommended collaborators may include:

- Director of Assessment
- Director of Advising
- Math Department Chair

The study team recognizes that the degree and scope of the pilot programs' implementation is diverse across campuses. Questions in this survey are not part of an audit or compliance review, but instead provide crucial qualitative information toward understanding implementation differences across campuses. Information you provide will not affect funding or personnel decisions at your institution.

Please submit your responses by **Wednesday, Jan. 31**. Survey responses are being collected, reviewed, and analyzed by the UMass Donahue Institute. If you have any questions about the survey, please contact David Kassabian at dkassabian@donahue.umassp.edu or (774) 455-7359.

I. Developmental Math Pilot Implementation

When completing this survey, please think about pilot programs related to the criteria used to place entering students who are recent high school graduates into their first college math course (developmental and/or college-level), referred to as "math placement pilot programs" or simply "pilots" in the remainder of this survey.

1. **Is your institution conducting any math placement pilot programs for the current (2017–2018) academic year?**
   O Yes
   O No

2. *[If yes to Q1]* **How many math placement pilot programs are being implemented at your campus for the current (2017–2018) academic year?** (Please consider each set of standards used a separate pilot program.)
   Response options: drop down menu of 1 to 5.

[Prompt if institution is implementing one pilot program in the current academic year] Please answer the following questions about the pilot program being implemented during the current (2017–2018) academic year.

[Prompt if institution is implementing more than one pilot program for the current academic year] To help us better understand the pilot programs being implemented by your institution during the current academic year, the following series of questions will ask about each of the pilot programs individually. For each series of questions, please consider only one pilot program. *[This sequence of questions repeats for the number of pilots reported]*

3. **Which of the following, if any, best describes the pilot math placement standard employed in this pilot?**
   - O Weighted high school GPA of 2.7 or above
   - O Weighted high school GPA of 2.7 or above and grade of B or higher in Algebra II
   - O Weighted high school GPA of 2.7 or above and four years of high school math
   - O Other standard: _____

4. **If there are any additional math placement criteria in place—beyond what is reported in the question above—please describe those below:**

5. **Please describe the student population(s) eligible for placement under this pilot program.**

6. **When was this math placement pilot adopted?**

   Term (e.g., fall) |_____| Academic Year (e.g., 2014/2015) |_____|

7. **Since the adoption of this math placement pilot, have changes been made?** (Please select all that apply.)
   - O Yes, changes to the criteria used for placement
   - O Yes, changes to the student population(s) eligible for placement under the pilot
   - O Yes, other changes
   - O No,

8. *[Skip if no changes were made]* **Please briefly describe the changes made.**

9. *[Skip if no changes were made]* **When were these changes adopted?**

Term (e.g., fall) |_____| Academic Year (e.g., 2014/2015) |_____|

10. Please describe any challenges encountered in applying the criteria of this pilot.

11. **Please describe for which students the pilot is applied. How frequently and under what circumstances would students with similar academic backgrounds (i.e., high school GPA, placement score, or high school math-taking record) have different placements?**

[If institution implementing more than one pilot program for the current academic year, repeat above sequence of questions for each additional pilot reported]

12. Were there any math placement pilot programs at your institution that were implemented in prior years but discontinued (e.g., approved under fall 2013 BHE policy)?

O Yes
O No

13. *[Skip if no pilots were discontinued]* **Please briefly describe any discontinued math placement pilot programs and reasons for discontinuance.**

II. Campus-Level Services

The next questions ask about campus-level services and support at your institution, and changes that may have been made as a result of the math placement pilot.

14. What, if any, support services are available to recent high school graduates placed in <u>developmental math</u>? Please briefly describe.

15. *[Skip if no pilots offered]* **Have there been changes in any of the following as a result of your institution's implementation of a developmental math pilot?**

	Yes	No
Student support services	O	O
Student advising practices or processes	O	O
Developmental math course offerings	O	O
College-level gateway math course offerings	O	O
Instructional practices in developmental math courses	O	O
Instructional practices in college-level gateway math courses	O	O
Other programs or practices aimed at supporting students successfully complete their first college-level mathematics course	O	O

16. *[If changes reported in student support]* **Please briefly describe the changes in student support services made as a result of the math placement pilot and the reason(s) for those changes.**

17. *[If changes reported in student advising]* **Please briefly describe the changes in student advising practices or processes made as a result of the math placement pilot and the reason(s) for those changes.**

18. *[If changes reported in developmental math course offerings]* **Please briefly describe the changes made to developmental math course offerings (e.g., specific courses offered) made as a result of the math placement pilot and the reason(s) for those changes.**

19. *[If changes reported in developmental instruction]* **Please briefly describe any changes in instructional practices in developmental math course offerings (e.g., co-requisite education, sequencing of courses) as a result of the math placement pilot and the reason(s) for those changes.**

20. *[If changes reported in developmental instruction]* **Please briefly describe any other important changes made as a result of the math placement pilot.**

21. Do you believe that the math placement pilot(s) at your institution have contributed to improvement in instructional quality in <u>developmental</u> math courses?

O Yes
O No
O Not sure

[If yes] **Please explain:**

22. Please provide the name and contact information for the person completing this form (required).

Name: _____

Position: _____

Institution: _____

Appendix B

Appendix

Approach to Math Placement, Comparison by Institution

Institution	Profile, as reported to DHE (as of fall 2017)[1]					Profile, from survey (as of January 2018)	
	Pilot standard	Students with any determination	Ready students determined by pilot standards	Ready students determined by ACCUPLACER	Ready students determined by other	Pilot standard	Other placement criteria[2]
Berkshire Community College	A2	31%	95%	5%	0%	A2	ACCUPLACER
Bristol Community College	A1, A2	9%	91%	5%	3%	A1	
Bunker Hill Community College	A1	57%	61%	36%	3%	A1	
Cape Cod Community College	A1	95%	72%	0%	28%	A1	
Fitchburg State University	A1	29%	45%	55%	0%	A1	
Framingham State University	A3	91%	73%	11%	16%	A3	ACCUPLACER
Greenfield Community College	A2	89%	3%	0%	97%	A2	ACCUPLACER
Holyoke Community College	A2	94%	54%	46%	0%	A3	Placement test, AP credit, transfer credit
Middlesex Community College	A1	69%	62%	32%	6%	A1	
Mt. Wachusett Community College	A1	98%	60%	32%	8%	A1	ACCUPLACER, conversation with advisor
North Shore Community College	A1	36%	20%	36%	43%	A1	Communications proficiency; GPA 1; GED, PSAT, ACT, SAT scores
Northern Essex Community College	A1	90%	71%	29%	0%	A1	ACCUPLACER
Quinsigamond Community College	A3	79%	27%	71%	2%	A3	
Salem State University	A1	94%	50%	1%	49%	A3	SAT scores

Springfield Technical Community College	A2	92%	16%	83%	1%	A2	Placement test
Westfield State University	A1	100%	95%	5%	0%	A1	Matriculation as a business major; placement test

Note: only institutions using at least one pilot standard as of January 2018 are shown

[1] Compiled from HEIRS data

[2] Additional or alternative placement criteria reported for at least some students in some situations