

Assessing Multiple Measures: How have student outcomes changed?

Prepared for Southwestern Oregon Community College
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Project description

The Oregon community colleges have been implementing major changes to how they assess incoming students' college readiness, moving from relying on standardized placement exams to a multiple measures process. Using multiple measures is intended to increase the accuracy of students' initial math and English course placements and ultimately improve student success.

In this year-long project (September 2018 to July 2019), REL Northwest worked side-by-side with community college stakeholders from Clackamas Community College, Mount Hood Community College, Oregon Coast Community College, and Southwestern Oregon Community College to produce evidence related to the effectiveness of multiple measures.

This memo outlines the findings from an analysis that uses descriptive and regression methods to understand the influence of multiple measures (MM) placement on short-term student academic outcomes, comparing outcomes of students who were placed using traditional methods versus multiple measures at Southwestern Oregon Community College. This analysis also explores institutional outcomes related to total student enrollment in developmental education courses over time.

Overview of methods and findings

Using student level data from Southwestern Oregon Community College from fall 2016 to fall 2018, this analysis explores student outcomes in their first year: fall entrants through spring, winter entrants through the following fall, and spring entrants through the following winter. This analysis focuses on students who entered in the summer, fall, winter, and spring in two academic years—2016/17 and 2017/18—and in the fall term of 2018/19.¹ The analysis sample was limited to students 17 and older who enrolled in regular (i.e. not dual credit) coursework in English or math in their first academic year.

The analysis compares outcomes of students who were placed using multiple measures and those who were not for English and math. In 2016/17, 175 students were placed using multiple measures; in 2017/18, 366 students were placed using multiple measures; and in fall 2018/19 279

¹ Winter and spring entrants of 2018/19 were not included as a full academic year of data was not yet available at the time of this report.

students were placed using multiple measures. Figure 1 displays the number of MM versus non-MM students in each cohort year.

Figure 1. Number of students by entry year, 2016/17–2018/19

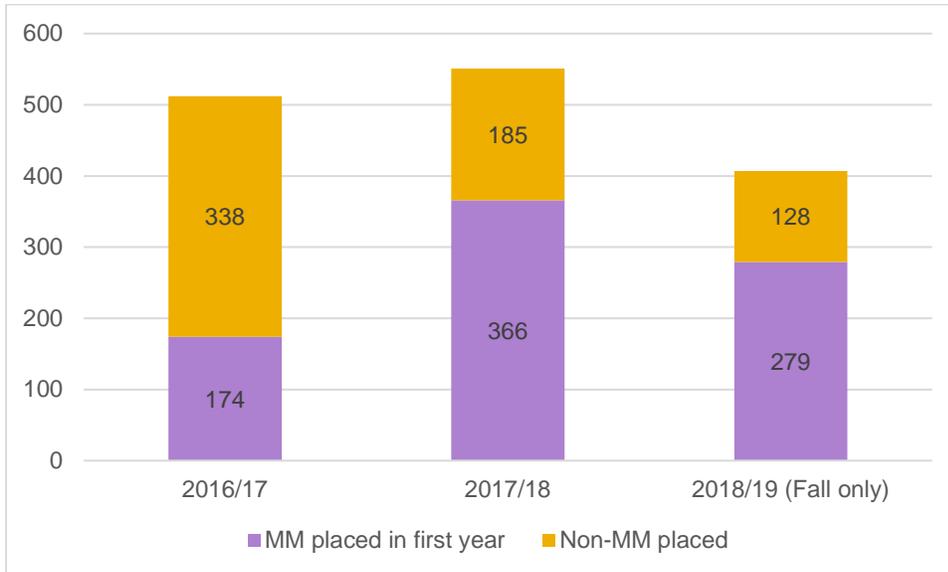


Figure notes:

- Sample includes students 17 and older who enrolled in regular (i.e. not dual credit) coursework in English or math in their first academic year.
- Total analysis sample sizes for each cohort are found by summing the two segments in each bar: 512, 551, and 407, respectively. The 2018/19 cohort only includes only fall entrants while all other cohorts include entrants from the fall, winter and spring terms.
- Separate records were provided for math and English placement methods. Thus, a student could have been placed using MM for math only, for English only, for both, or for neither. The totals shown here are for students who were placed using MM at any time in their first year (math only, English only, or both).

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

It is important to note that we have evidence that MM placed students tend to differ from non-MM placed students in ways other than placement method. Traditionally placed students (non-MM) are more likely to identify as a student of color and to be aged 25 or older in their first year. MM placed students are slightly more likely to identify as female. The groups are generally comparable in terms of the Pell and veteran distribution. Figure 2 shows the proportions of key demographics in our analysis sample. Differences in some of these key characteristics suggest that the descriptive analysis results should be interpreted with great caution; observed differences in student outcomes cannot be attributed to placement method.

We attempt to remedy this limitation by constructing a matched comparison group from the sample of non-MM students so that the two groups of students are much more comparable on these observed characteristics. But those results also carry a limitation; we may not have accounted for all student characteristics that are related to both placement method and student outcomes.

Figure 2. Characteristics of students in analysis, 2016/17–2018/19

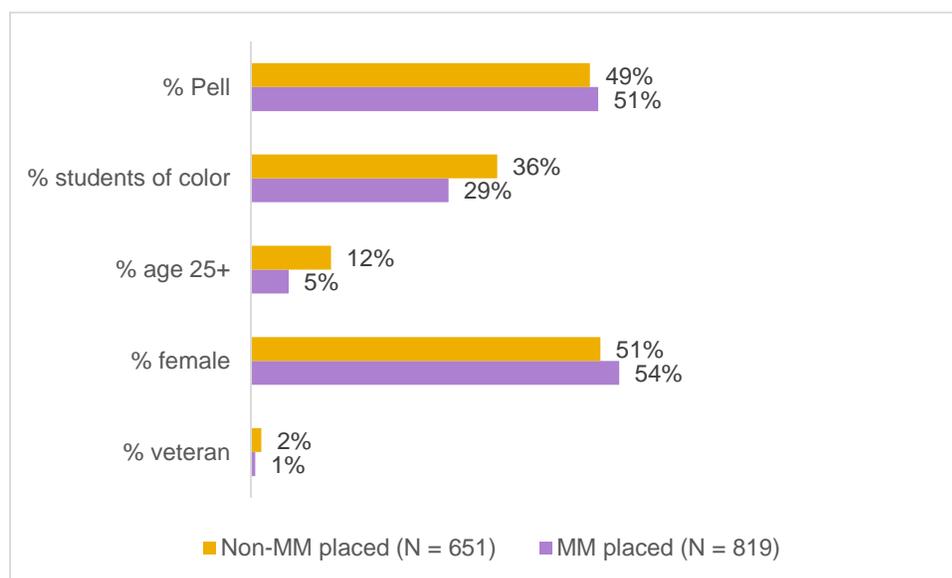


Figure notes:

- Students of color includes students who identified as African American, American Indian/Alaska Native, Asian, Hispanic, Multiracial, and Pacific Islander.
- Student age is calculated on July 1 of their cohort (entry) year.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

Overall, the analysis finds the following:

- When compared to a group of students with similar demographics, multiple measures placement is linked to better first year outcomes for students. A higher proportion of MM students progress into and complete college math and English at Southwestern Oregon Community College compared to students with similar demographic characteristics placed using traditional methods. As the results that do not account for available demographic characteristics show that, overall, MM students have lower first year outcomes than non-MM students, we suspect that lower-performing students are opting into MM placement over traditional methods.
- MM students do not do as well in their first math course as non-MM students, and they progress into college math in their first year at similar rates and do the same as non-MM students in college math. However, some student groups placed using MM, particularly students of color, have much lower outcomes than their counterparts placed using traditional methods.
- English outcomes are stronger than math outcomes, with more MM students enrolling in college English in their first year. Pass rates for the first English course and for college-level English in the first year are comparable. This may signal that MM is accelerating progression into and completion of college English.
- Regarding enrollment in developmental education courses in the two years for which data were available, there was a substantial drop in the number of students enrolled in developmental mathematics over the course of three years and complementary increase in college-level enrollments. In English, there was a substantial increase in the number of enrollments overall, driven by a higher number of college-level enrollments in 2017/18.

Descriptive results

By cohort, we first present the primary outcomes of the proportion of students who were successful in their first math/English course, progressed into and passed college-level or terminal² math/English in the first year of college, and persisted to a second term (tables 1-3). Bolded numbers in the tables represent practically significant differences in outcomes, using a 5% difference threshold, which means that the differences are large enough to be potentially meaningful. We do not report statistical significance as it is heavily influenced by sample size. There are many differences in outcomes that are large and meaningful, but not significant due to low sample sizes, or outcomes that are small and not meaningful, but significant due to large sample sizes.

The analysis of outcomes of students who took math in their first year (Table 1) finds that:

- A lower proportion of MM than non-MM students passed their first math course (55 percent compared with 65 percent). *Findings presented in Table 4 illustrate that more supports may be needed for students who first enroll in the lower developmental math courses as pass rates are lower for MM students compared to non-MM students in those courses.*
 - *Subpopulation findings:* Subgroups of MM students tend to have lower pass rates in their first math course compared with non-MM students, and these differences substantial for Pell students (52 percent compared with 61 percent), students of color (45 percent compared with 62 percent), and younger students (55 percent compared with 66 percent).
- Although pass rates in the first math course were lower for MM students, a similar proportion of MM students enrolled in college-level math in their first year as non-MM students (56 percent compared with 55 percent).
 - *Subpopulation findings:* Compared with non-MM students, college math enrollment rates were substantially lower for students of color (50 percent compared with 56 percent) and younger students (13 percent compared with 39 percent).
- Among all students, college math pass rates were lower for MM students than non-MM students (36 percent compared with 40 percent), but this did not reach our threshold for a substantial difference. The pattern of differences in college math pass rates mirror the college enrollment rates shown in the rows immediately above.
 - *Subpopulation findings:* College math pass rates were lower for MM students of color and younger students compared with non-MM peers (28 percent compared with 41 percent and 10 percent compared with 34 percent, respectively).
- Among college math enrollees, college math pass rates of MM and non-MM students were comparable (67 percent compared with 70 percent).

² For the math outcomes, we included terminal math coursework for students in career and technical education (CTE) programs. These math courses are numbered 80 through 89 and are the highest math courses students in those programs are expected to take. Any reference to “college-level” math throughout this document includes both college-level courses (numbered 100 or higher) and these terminal courses (numbered 80 through 89).

- *Subpopulation findings:* Among college math enrollees, college math pass rates of MM Pell students and students of color were substantially lower than their non-MM peers (61 percent compared with 67 percent and 55 percent compared with 73 percent, respectively).

Table 1. Outcomes measuring student success in math courses among students who took math in first year, 2016/17–2018/19

	Not placed using MM <i>N</i> = 677	Placed using MM <i>N</i> = 553
Passed first math course		
Full sample	65%	55%
Pell students	61%	52%
Students of color	62%	45%
Students aged 17-24	66%	55%
Students aged 25+	62%	59%
Enrolled in college-level or terminal math in first year		
Full sample	56%	55%
Pell students	53%	50%
Students of color	56%	50%
Students aged 17-24	58%	58%
Students aged 25+	39%	13%
Passed college-level or terminal math in first year (all students)		
Full sample	40%	36%
Pell students	35%	31%
Students of color	41%	28%
Students aged 17-24	40%	38%
Students aged 25+	34%	10%
Passed college-level or terminal math in first year (among college math enrollees)	<i>N</i> = 381	<i>N</i> = 302
Full sample	70%	67%
Pell students	67%	61%
Students of color	73%	55%
Students aged 17-24	69%	66%
Students aged 25+	88%	*

Table notes:

- *Indicates that the cell was suppressed due to the sample size being less than 10 students.
- Bolded numbers mean the difference in the proportion of MM and non-MM students meeting an outcome is at least 5 percentage points.
- Passed = Grade of A, B, or C.
- First year = student's first full academic year: Summer and fall entrants are tracked through spring; winter entrants are tracked through fall of the following year; spring entrants are tracked through winter of the following year.
- Students of color includes students who identified as African American, American Indian/Alaska Native, Asian, Hispanic, Multiracial, and Pacific Islander.
- Student age is calculated on July 1 of their cohort (entry) year.
- College-level courses are any courses with a number 100 or higher. Terminal courses for CTE students are those with a number 80 through 89. As some credential/degree programs do not require math coursework at or above the 100 level. As such, students attaining math success within their specific program may be underrepresented in these proportions.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

The analysis of outcomes of students who took English in their first year (Table 2) finds that:

- Nearly the same proportion of MM and non-MM students passed their first English course in their first year.
 - *Subpopulation findings:* Within key subgroups, the proportions of MM students and non-MM students who passed their first course in English were comparable.
- A higher proportion of MM than non-MM students enrolled in college-level English in their first year (98 percent compared with 90 percent).
 - *Subpopulation findings:* All subgroups of MM students enrolled in college English at substantially higher rates than their non-MM peers (note that the older student subgroup results cannot be reported as the cell sizes are too small).
- A slightly higher, but not substantial, proportion of MM and non-MM students passed college English in their first year (73 percent compared with 70 percent). *This finding, along with the previous, suggests that students placed using MM are progressing into college-level English coursework faster and performing similarly to their non-MM peers in those courses.*
 - *Subpopulation findings:* All subgroups have a higher proportion of MM students than non-MM students passing college English, and the difference for students of color is substantial. More MM students of color (77 percent) passed college-level English in their first year than non-MM students of color (66 percent).
- Among college English enrollees, college English pass rates of MM and non-MM students were similar (75 percent and 78 percent). This means more MM students progressed into college English, and they performed the same as non-MM students.
 - *Subpopulation findings:* All subgroups have similar pass rates as well.

Table 2. Outcomes measuring student success in English courses among students who took English in their first year, 2016/17–2018/19

	Not placed using MM <i>N</i> = 820	Placed using MM <i>N</i> = 419
Passed first English course		
Full sample	74%	72%
Pell students	72%	68%
Students of color	71%	74%
Students aged 17-24	74%	72%
Students aged 25+	79%	*
Enrolled in college-level English in first year		
Full sample	90%	98%
Pell students	90%	97%
Students of color	87%	95%
Students aged 17-24	89%	98%
Students aged 25+	93%	*
Passed college-level English in first year (all students)		
Full sample	70%	73%
Pell students	66%	68%
Students of color	66%	77%
Students aged 17-24	69%	73%
Students aged 25+	74%	*

Passed college-level English in first year (among college English enrollees)		
Full sample	78%	75%
Pell students	74%	70%
Students of color	77%	81%
Students aged 17-24	78%	75%
Students aged 25+	80%	*

Table notes:

- *Indicates that the cell was suppressed due to the sample size being less than 10 students.
- Bolded numbers mean the difference in the proportion of MM and non-MM students meeting an outcome is at least 5 percentage points.
- Passed = Grade of A, B, or C.
- First year = student's first full academic year: Summer and fall entrants are tracked through spring; winter entrants are tracked through fall of the following year; spring entrants are tracked through winter of the following year.
- Students of color includes students who identified as African American, American Indian/Alaska Native, Asian, Hispanic, Multiracial, and Pacific Islander.
- Student age is calculated on July 1 of their cohort (entry) year.
- English = reading (RD), writing (WR), integrated reading-writing (WR90R), and English (ENG) courses. College-level coursework are any courses with a number 100 or higher.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

Second-term persistence rates are similar for MM students compared with their traditionally placed peers (Table 3).

Table 3. First to second term persistence among students who took math and/or English in their first year, 2016/17–2018/19

	Not placed using MM <i>N = 651</i>	Placed using MM <i>N = 819</i>
First-to-second term persistence	83%	84%
Full sample	84%	85%
Pell students	82%	85%
Students of color	84%	84%
Students aged 17-24	80%	82%
Students aged 25+	83%	84%

Table notes:

- *Indicates that the cell was suppressed due to the sample size being less than 10 students.
- Students of color includes students who identified as African American, American Indian/Alaska Native, Asian, Hispanic, Multiracial, and Pacific Islander.
- Student age is calculated on July 1 of their cohort (entry) year.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

To understand how outcomes vary by the level of the first math and English course students took, we present, by their first course, the proportion of students who passed their first course, progressed into college-level coursework, and passed college-level coursework (Table 4).

The analysis of outcomes of students who took math in their first year by course starting level (Table 4) finds that:

- There is not a substantial difference in the level of math that MM and non-MM students are taking as their first enrollment: 44 percent of MM students enroll in college-level compared with 45 percent of non-MM students. Within the developmental education

courses, there are substantially more students who were MM placed enrolling in Math 95 first and fewer in Math 60 than non-MM students (13 percent compared with 5 percent and 9 percent compared with 15 percent, respectively).

- Pass rates for the first math course are comparable for MM and non-MM students who take college-level coursework as their initial math enrollment (32 percent and 34 percent). However, for development education courses, the pass rate for MM students is substantially lower than for non-MM students (46 percent compared with 65 percent). For all DE courses, with the exception of Math 98, pass rates for MM placed students are lower than non-MM placed students. *These findings suggest that MM placed students are successful in college-level and the highest-level DE course (for the non-algebra track), but MM students in other DE courses may be struggling and in need of more support. It may also suggest that students placed into DE coursework using traditional methods may be being under-placed.*
- Though pass rates in the first course are lower for MM students in DE, rates of enrollment in college-level coursework in the first year are comparable (19 percent and 21 percent). Within the DE courses, a similar pattern of differences is evident in rates of college-level math enrollment in the first year as for first course passing rates above. Rates for those who took Math 98 as their first math enrollment are higher for MM students than non-MM students (49 percent compared with 40 percent), but substantially lower for all other DE courses.
- In terms of passing college-level math in the first year, MM students have a slightly lower rate (9 percent) than non-MM students (13 percent). MM students have a substantially lower rate in Math 95, Math 65, and Math 20 (11 percent compared with 32 percent, 5 percent compared with 12 percent, and 1 percent compared with 12 percent, respectively).

Table 4. Outcomes measuring student success in math courses, by first math course, among students who took math in first year, 2016/17–2018/19

	Not placed using MM	Placed using MM
First math course:		
College-level or terminal	45%	44%
Any developmental math	55%	56%
MTH 98	8%	7%
MTH 95	5%	13%
MTH 65	9%	10%
MTH 60	15%	9%
MTH 20	19%	17%
Passed first math course, by first math course:		
College-level or terminal	34%	32%
Any developmental math	65%	46%
MTH 98	72%	80%
MTH 95	77%	38%
MTH 65	52%	27%
MTH 60	65%	45%
MTH 20	64%	47%
Enrolled in college-level math in first year, by first math course:		
Any developmental math	21%	19%

	Not placed using MM	Placed using MM
MTH 98	40%	49%
MTH 95	48%	30%
MTH 65	21%	11%
MTH 60	7%	12%
MTH 20	17%	5%
Passed college-level math in first year, by first math course:		
Any developmental math	13%	9%
MTH 98	25%	29%
MTH 95	32%	11%
MTH 65	12%	5%
MTH 60	3%	6%
MTH 20	12%	1%

Table notes:

- Bolded numbers mean the difference in the proportion of MM and non-MM students meeting an outcome is at least 5 percentage points.
- Passed = Grade of A, B, or C.
- First year = student's first full academic year: Summer and fall entrants are tracked through spring; winter entrants are tracked through fall of the following year; spring entrants are tracked through winter of the following year.
- College-level courses are any courses with a number 100 or higher. Terminal courses for CTE students are those with a number 80 through 89. As some credential/degree programs do not require math coursework at or above the 100 level. As such, students attaining math success within their specific program may be underrepresented in these proportions.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

The analysis of outcomes of students who took English their first year by course (Table 5) finds that:

- Substantially more students placed using MM took college-level English as their first English course than non-MM students (95 percent compared with 78 percent).
- Pass rates within college-level English for students who took college-level as their first enrollment are comparable for MM and non-MM students. Within developmental education, however, MM students have a lower pass rate than non-MM students (61 percent compared with 66 percent).
- In terms of progressing to a college-level enrollment within the first year, rates in developmental education are comparable for MM and non-MM students (57 percent and 53 percent).
- MM students have a lower rate of passing college-level English in their first year than non-MM students (22 percent compared with 35 percent).

Table 5. Outcomes measuring student success in English courses, by first English course, among students who took math in first year, 2016/17–2018/19

	Not placed using MM	Placed using MM
First English course:		
College-level English	78%	95%
Any developmental English	22%	5%
WR 90 R	13%	4%
WR 95	<1%	0%
WR 90	4%	1%

	Not placed using MM	Placed using MM
WR 80	4%	0%
RD 90	<1%	<1%
RD 80	2%	0%
Passed first English course, by first English course:		
College-level English	23%	28%
Any developmental English	66%	61%
WR 90 R	65%	44%
WR 90	81%	*
WR 80	60%	
RD 80	71%	
Enrolled in college-level English in first year, by first English course		
Any developmental English	53%	57%
WR 90 R	52%	50%
WR 90	72%	*
WR 80	37%	
RD 80	57%	
Passed college-level English in first year, by first English course		
Any developmental English	35%	22%
WR 90 R	35%	6%
WR 90	47%	*
WR 80	23%	
RD 80	43%	

Table notes:

- *Indicates that the cell was suppressed due to the sample size being less than 10 students. Blank cells indicate no student took the given course in the given year.
- Bolded numbers mean the difference in the proportion of MM and non-MM students meeting an outcome is at least 5 percentage points.
- Reading and writing DE enrollments may not be mutually exclusive. Students may be concurrently enrolled in, for example, RD 90 and WR 90 in their first term; these students are counted in both rows.
- Passed = Grade of A, B, or C.
- First year = student's first full academic year: Summer and fall entrants are tracked through spring; winter entrants are tracked through fall of the following year; spring entrants are tracked through winter of the following year.
- English = reading (RD), writing (WR), integrated reading-writing (WR90R), and English (ENG) courses. College-level coursework are any writing courses with a number 100 or higher.
- Outcome rows for WR 95 and RD 90 have been removed as the sample size for each cell is less than 10 students.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

Analyzing total number of enrollments in fall for college-level and developmental math and English courses from 2015/16 to 2017/18 (Table 6, Figure 3, and Figure 4), we find that:

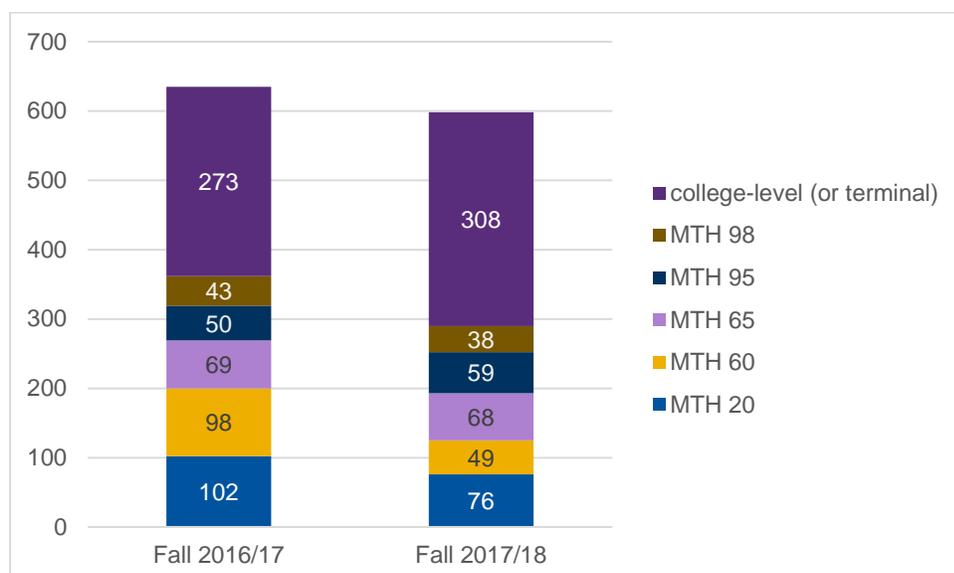
- Overall, there is a slight drop in the total number of enrollments for math coursework and an increase in enrollments for English coursework.
- There is a clear drop in enrollments in developmental math courses in fall 2017 and increase in college-level enrollments (even though the total number of enrollments decreased).
- The number of developmental English (reading and writing) courses is comparable over the two years shown here. There is an increase in the number of college-level enrollments which drives the increase of English enrollments overall.

Table 5. Total number of enrollments in fall in math and English courses, 2016/17–2017/18

	Fall 2016/17	Fall 2017/18
Number of college-level (or terminal) math enrollments	273	308
Number of developmental math enrollments	362	290
Number of MTH 98 enrollments	43	38
Number of MTH 95 enrollments	50	59
Number of MTH 65 enrollments	69	68
Number of MTH 60 enrollments	98	49
Number of MTH 20 enrollments	102	76
Number of college-level English enrollments	527	702
Number of developmental English enrollments	104	121
Number of WR 90 R enrollments	20	61
Number of WR 95 enrollments	0	48
Number of WR 90 enrollments	49	0
Number of WR 80 enrollments	15	12
Number of RD 90 enrollments	7	0
Number of RD 80 enrollments	13	0

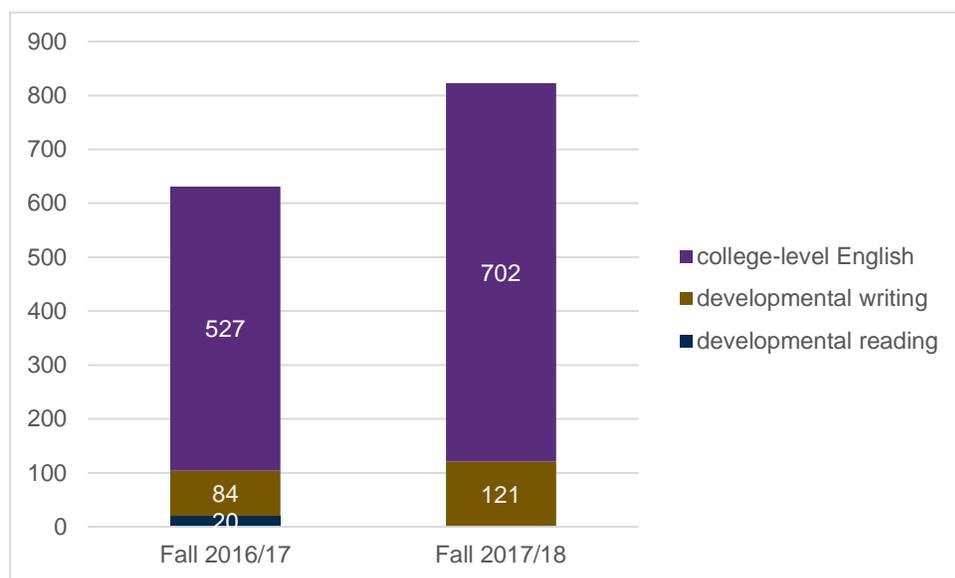
Source: REL Northwest analysis of student-level data from Higher Education Coordinating Commission

Figure 2. Fall term math enrollment over time, 2016/17–2017/18



Source: REL Northwest analysis of student-level data from Higher Education Coordinating Commission

Figure 3. Fall term English enrollment over time, 2016/17–2017/18



Source: REL Northwest analysis of student-level data from Higher Education Coordinating Commission

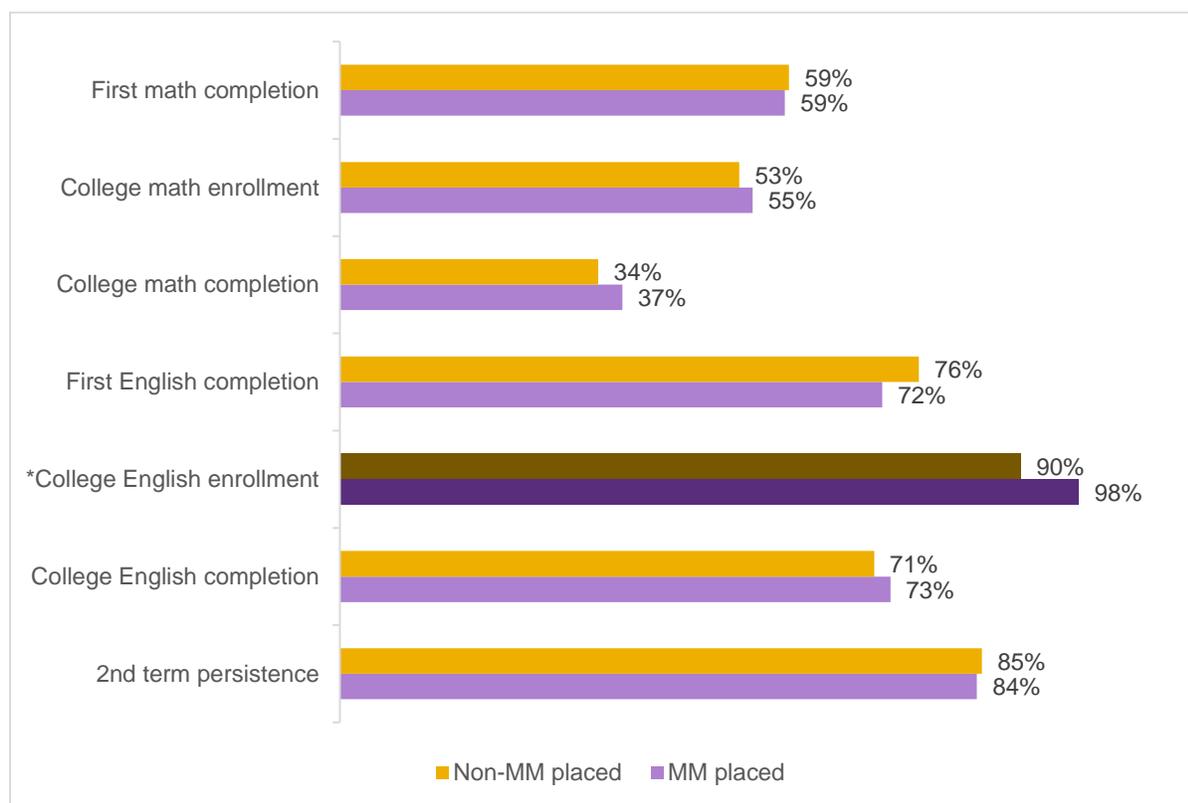
Regression results

To isolate the contribution of multiple measures on students' success in their first English/math course, progression and success in college English/math their first year of college, and first-to-second term college persistence, this analysis compares outcomes of MM students and a *matched comparison group* of non-MM students across cohorts in the analytic sample.³ These statistical methods account for the contribution of student characteristics (race/ethnicity, gender, age, veteran status, and Pell Grant receipt) on outcomes to better identify the direct influence of multiple measures on outcomes. The results are displayed in Figure 5 as marginal effects—the estimated probability, averaged over cohorts, of achieving each outcome for students placed using MM and similar students placed using traditional methods.

Overall, we find no substantial difference for MM students in passing the first math course, college math enrollment in the first year, college math completion in the first year, passing the first English course, college English completion in the first year, and first-to-second term persistence compared with similar non-MM students. There are minimal differences, but they do not meet our threshold of 5%. Only one of the outcomes we examined, enrolling in college-level English in the first year, had a substantial difference between MM and non-MM placed students: 98% of MM placed students enrolled in college English compared to 98% of similar non-MM students.

³ Three matched samples were used to reflect the samples used in the tables in previous sections: math course takers only, English course takers only, and math or English course takers.

Figure 4. Predicted outcomes for MM students and matched non-MM students



Notes:

- The bars shaded darker indicate that the difference between non-MM and MM probabilities are practically significant (differences are 5% or greater). Statistical significance at the 5% level is denoted with an asterisk in the outcome label (*).
- Predicted probabilities for each group are shown as a weighted average over cohort years.

Source: REL Northwest analysis of student-level data from Southwestern Oregon Community College.

Additional project information

Data files and analysis details

Southwestern Oregon Community College provided Education Northwest with data files with the following information:

1. Student information with demographic information on all students who entered SOCC between fall 2016/17 and fall 2018/19 with a unique identifier to link to the course enrollment spreadsheet.
2. Course enrollment and completion data for all students in the three analysis cohorts from fall 2016 through spring 2019.
3. Placement information that included the type of placement (multiple measures or not), date of placement, and the subject (math or English).

The datasets were cleaned using Stata 15 and merged using the unique student identifier provided.

A student's entry cohort was determined by their first enrollment in a course coded as "RG" (regular coursework). Students enrolled dual credit courses were not considered as entrants. Student age was calculated on July 1 of their cohort year using the provided birthdate in the student file. The analytic sample was limited to students who were aged 17 or older in order to further filter out high school students enrolled in coursework.

The analytic sample only includes students who enrolled in math and/or English coursework in their first year. Students who had no math and no English enrollments, college-level or otherwise, were not included in the analytic sample.

As noted earlier, student outcomes were tracked for an academic year. We define an academic year as the time span required to complete three "traditional" terms (fall, winter, and spring) based on the entry term. Summer term enrollments and completions were included for winter and spring entrants.

Not all students enrolled in math or English coursework in their initial entry term. The first math and the first English course taken in the first academic year was considered the initial enrollment for each subject area. It is possible for a student to be enrolled in more than one math or English course in their term of initial enrollment, and these may be at different developmental education levels. In these cases, the highest (closest to college level) level course was considered the initial enrollment.

Regression methods

At Southwestern Oregon Community College, not all students were placed into their first math or English course using MM, so we matched MM and non-MM students and examined the influence of MM on student outcomes. We first predicted the likelihood of being a MM-placed student, given race/ethnicity, gender, age, veteran status, and Pell Grant receipt status (Equation 1). This model produced propensity scores that allowed us to match MM and non-MM students.

$$(1) \quad \text{logit}(MM_i = 1) = \alpha + \beta X_i$$

Once we constructed a matched comparison group, we used regression analysis to identify the strength and direction of the influence of MM on the outcomes of interest. The outcome model is provided in Equation 2. For the outcome model, we included fixed effects for cohort year; the vectors denoted β_C (coefficients) and C_i (cohort indicators) reflect the inclusion of these fixed effects.

$$(2) \quad \text{logit}(Outcome_i = 1) = \alpha + \beta_1(MM) + \beta_C C_i$$

Three matched analytic samples were used for the outcome models. For the math outcomes, we created a matched sample using only those students who took at least one math course in their

first year (analogous to Table 1). For the English outcomes, we created a matched sample using only those students who took at least one English course in their first year (analogous to Table 2). For the persistence outcome, we included all students who took either a math or English course in their first year (analogous to Table 3).

Estimates of coefficients were used to calculate marginal predicted probabilities for MM and non-MM students. Predicted probabilities were averaged over cohorts, so the resulting probabilities represent average predictions across the 2016/17 through 2018/19 cohorts.

For questions about the multiple measures project, **contact Michelle Hodara at Michelle.Hodara@educationnorthwest.org**.