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Increasing Access to College-Level Math: Early Outcomes Using the Virginia Placement Test

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In fall 2009, the Virginia Community College System (VCCS) embarked on a redesign of developmental education that has begun to make significant changes to developmental math and English curricula, course structures, and placement instruments. One of the central goals of this statewide reform is to reduce the need for developmental education.[1] This brief explores the progress toward meeting this goal by examining one aspect of the reform, the implementation of a diagnostic placement instrument for math known as the Virginia Placement Test–Math (hereafter, VPT).[2] The VPT is intended to improve placement accuracy by better matching students with newly created developmental math modules or traditional college math courses based on their proficiency in competencies required for specific programs of study.[3]

In this brief, I compare the entry-level college math course placement rates of two cohorts—one comprised of students who took a placement exam and first enrolled in college before the VPT was introduced (the fall 2010 cohort) and another comprised of students who took a placement exam and first enrolled after the VPT was established (the fall 2012 cohort).[4] Whereas all students in the fall 2010 cohort took the COMPASS, almost all students in the fall 2012 cohort took the VPT. I go on to compare the entry-level college math enrollment and pass rates of students in each cohort *who placed into college math*. This study thus focuses on the outcomes of students who placed into introductory college-level math before and after introduction of the VPT; it does not consider the outcomes of students who were assigned to developmental education.

Prior to the spring 2012 term, all 23 colleges in the VCCS delivered developmental mathematics using some variant of the traditional course sequence (arithmetic, pre-algebra, beginning algebra, and intermediate algebra), and all of the colleges utilized the computer-adaptive COMPASS exam to assign students to college-level or developmental math courses. All degree-seeking students, whether they were enrolled in liberal arts programs or STEM programs, needed to demonstrate competency through the intermediate algebra level to enroll in college-level math.

Increasing access to college-level math courses may result in a tradeoff between higher overall enrollment and completion rates and lower conditional pass rates.

In fall 2011, as part of the developmental math redesign, the VCCS implemented a new placement policy, with different math competencies required for the entry-level college math courses in liberal arts and STEM programs.[5] The VCCS developmental math redesign team analyzed the college-level mathematics and quantitative reasoning competencies required for the various programs of study and decided to divide the developmental math curriculum into nine different modules. The modules cover topics ranging from operations with positive fractions in module 1 to functions, quadratic equations, and their graphical representations in module 9.

The redesign team determined that liberal arts majors would be required to demonstrate proficiency in the content covered in modules 1 through 5, either by passing a new diagnostic placement test (the VPT) on that content or by completing the developmental modules; STEM majors would be required to demonstrate proficiency in the content covered in all nine modules; and the math requirements for career-technical education/vocational programs would vary depending on the specific program (most requiring proficiency in the first three modules).[6] Thus, the redesigned system was expected to increase the rate of college-level math placements by reducing the developmental math requirements for liberal arts programs.

Data and Methods

I report on a descriptive analysis of students' enrollment and performance in the introductory college-level math courses that are required for liberal arts and STEM programs of study in the VCCS.[7] The analysis uses statewide data for all first-time-in-college students who took a placement test and enrolled in a VCCS college prior to the implementation of the VPT (fall 2010 cohort, $N = 19{,}059$) and those who did so two years later, after the VPT had been implemented (fall 2012 cohort, $N = 20{,}457$). There were no significant differences between the two cohorts in terms of race/ethnicity, gender, and part-time/full-time enrollment status. All students in the fall 2010 cohort took the COMPASS. Ninety-five percent of students in the fall 2012 cohort took the VPT (the remaining students in that cohort took the COMPASS). Course enrollment and performance outcomes of both cohorts were tracked for one year (over the fall, spring, and summer terms). A statistical examination of the differences in group means (*t*-test) indicates that all findings cited below are statistically significant at the one-percent level.

Findings

Placement and Enrollment Rates in College Math Increased

As shown in Figure 1, a greater proportion of students placed into entry-level college math during the fall 2012 semester, in which the VPT was used for placement (43 percent), than in the fall 2010 semester, in which the COMPASS was used (11 percent). Liberal arts college math placements grew from 4 to 10 percent; STEM college math course placement rates increased from 7 to 33 percent.[8]

As shown in Figure 2, the increase in entry-level college math course placements was accompanied by an increase

Figure 1. College Math Placement Rates

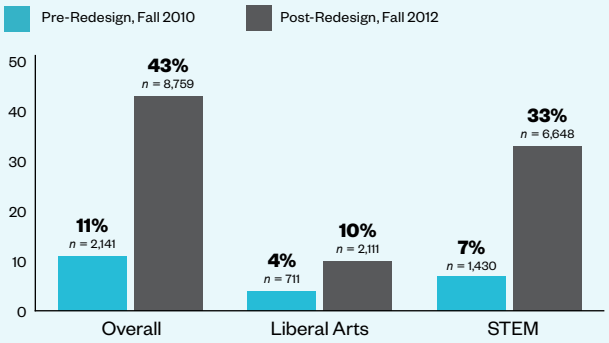
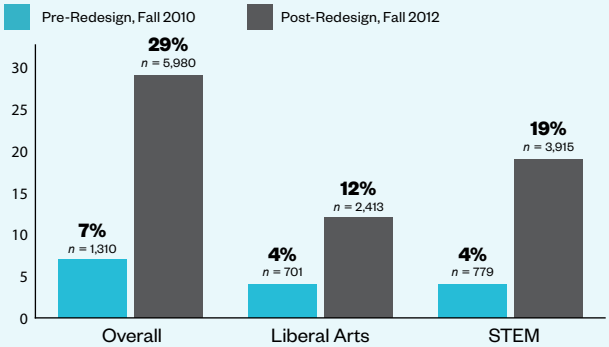


Figure 2. Percentage of Students Who Placed Into and Enrolled in College Math

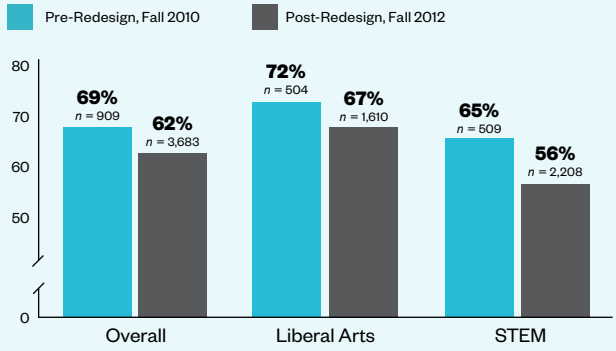


in entry-level college math course enrollments within one year by students who placed into those courses.[9]

Conditional Pass Rates in College Math Declined

Among the subset of students in each cohort who placed into college math and who enrolled in an entry-level college math course within one year, there were lower average pass rates (defined as earning a C or better) after implementation of the VPT (see Figure 3). For liberal arts math courses, the fall 2012 cohort pass rate was 5 percentage points lower than the fall 2010 cohort pass rate. For STEM math courses, the fall 2012 cohort pass rate was 9 percentage points lower.

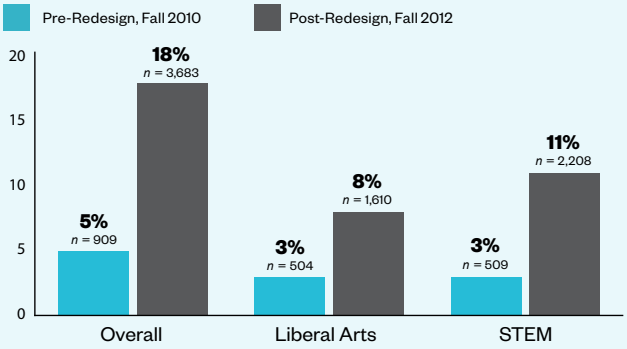
Figure 3. Pass Rates Among Students Who Placed Into and Enrolled in College Math



Completion Rates in College Math Increased

When all students who placed into college math are taken into account—not just those who enrolled in a college math course but also those who never attempted one—results indicate that a larger percentage of college-math-placed students successfully completed entry-level college math (with a C or better) after the introduction of the VPT. Figure 4 shows these results in terms of the percentage of all students in each cohort who placed into and passed college math.[10] Eighteen percent of students in the fall 2012 cohort placed into and completed introductory college math within one year, compared with 5 percent of students in the fall 2010 cohort. The relative increase in the STEM pass rate was greater than that in the liberal arts pass rate.

Figure 4. Percentage of Students Who Placed Into and Successfully Completed College Math



Discussion

The findings from this analysis highlight a tradeoff that should be acknowledged when planning reforms to reduce remedial placement rates using a placement instrument. On the one hand, after the VPT was introduced, more students placed into and enrolled in college-level math courses, and these higher enrollments boosted completion rates, suggesting that the new placement policy and assessment instrument served to increase overall student progression. On the other hand, pass rates among those who enrolled declined modestly, suggesting that colleges may need to offer more support to improve the performance of some students who place into and enroll in college-level math.

The results also show more than a four-fold increase in both placement and enrollment rates for STEM college math courses after the VPT was introduced, suggesting that the change in policy and use of the VPT affected these rates substantially. In addition, interviews with personnel at some colleges suggest that the large enrollment growth in STEM math courses could also have been influenced by changes in math prerequisites for STEM students, changes in transfer requirements, and changes in guidance from advisors. For instance, one of the larger colleges in the VCCS eliminated college algebra as a prerequisite for precalculus (an introductory STEM math course), likely increasing the enrollment of students in precalculus. Moreover, some transfer institu-

tions began promoting, if not requiring, precalculus as the preferred transferable math course, potentially boosting enrollment in STEM math among students in liberal arts programs as well as those in STEM programs.

Implications

This study addresses one facet of Virginia's developmental education redesign—a change in math placement policy undertaken in conjunction with a new assessment—by examining college math placement rates and the enrollment rates and performance of college-math-placed students in those courses. Since there may have been other changes occurring in the experience of the sampled students and because this is a descriptive study, it should not be interpreted as a causal analysis of the effects of the new placement policy or the VPT. Nonetheless, this study exposes an unintended (but not surprising) consequence of higher placement and enrollment rates in college-level math courses—lower conditional pass rates in these courses. Colleges may have to tolerate lower conditional pass rates, at least initially, in order to facilitate more students attempting such courses, leading to higher college-level math completion rates. Changes to how academic supports are deployed and changes to teaching and learning strategies used in college math courses could improve the conditional pass rates for these courses over time.

The findings of this study are consistent with the literature on developmental education placement and progression. The new placement policy decreased the remedial math requirements to which students might otherwise have been subjected (particularly for liberal arts students). The literature suggests that shortening the remedial sequence may be beneficial because it reduces the likelihood that students will be derailed by external forces before completing their developmental education requirements (Bailey, Jeong, & Cho, 2010; Edgecombe, 2011).

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There is also evidence in the literature that students scoring near the college-readiness cutoff may be better served by having the opportunity to enroll in college-level courses (Calcagno & Long, 2008; Martorell & McFarlin, 2011). However, if more students are placed directly into college-level math and need additional support but do not receive it, conditional college math pass rates will likely fall, and faculty may find these courses more difficult to teach (Jaggars & Hodara, 2011; Jaggars, Hodara, Cho, & Xu, in press).

Researchers contend that when the pool of students admitted to college-level courses broadens, additional supports should be provided in order to offset a decline in pass rates (Jaggars & Hodara, 2011; Jaggars et al., in press; Scott-Clayton, 2012). For example, colleges could evaluate which students are likely to struggle in the college-level math courses and adopt a corequisite model for those students; corequisite models have shown positive effects (Cho, Kopko, Jenkins, & Jaggars, 2012). Employing a well-implemented corequisite model, requiring students to receive supplemental instruction that supports their performance in the college-level course, may be a better alternative than assigning those students to developmental math. More research is needed to understand the full magnitude of the impact of college-level math placements on students who are most likely to be affected by changes in placement policy. It may be the case, for example, that some students who place into introductory college-level math and fail the course nevertheless have better college outcomes than those who place into and complete developmental math.

The findings of this study also signal the need for refinements to the instructional design and delivery of these courses. Ideally, the faculty members teaching the courses would lead this process, first identifying the obstacles that students are encountering and then making improvements to address those obstacles (see Edgecombe, Cormier, Bickerstaff, & Barragan, 2013, p. 28, for more on this process). Changes to the courses may occur at the level of specific lessons (Yoshida, 1999) or may entail full course redesigns (Twigg, 1999).

Given the substantial increase in college-level math placements found in this study, more research is needed to

better understand the placement accuracy of the VPT and COMPASS (see Scott-Clayton, 2012). Moreover, analysis of the impact of assignment to remedial or college-level courses is also needed to better assess the overall effectiveness of the reform. Forthcoming analyses that track VCCS students—both those who place into remedial courses and those who place into college-level courses—over longer periods should indicate whether some of the issues raised by this study endure as faculty, staff, and students in Virginia community colleges adapt to new assessment and placement policies and other features of the redesign.

Endnotes

1. Two other central goals of the redesign are to reduce the time students spend in developmental education and to increase the number of developmental education students who go on to graduate or transfer. As relevant data become available, additional CCRC research will examine progress toward meeting these two goals.
2. The VPT-English and redesigned developmental English courses were introduced in fall 2012 and spring 2013, respectively. A study of the impact of changes to the English assessment and placement system is forthcoming.
3. The redesign did not make any changes to the college-level math curriculum.
4. Some students who first enrolled in fall 2010 and in fall 2012 did not take a placement exam; typically, they were exempted from the exam through ACT or SAT scores. They are not included in this analysis.
5. Entry-level college math courses that fulfill requirements for liberal arts programs include Introduction to Elementary Statistics and Mathematics for Liberal Arts; entry-level college math courses that fulfill requirements for STEM programs include Precalculus I and Precalculus with Trigonometry.
6. The liberal arts requirements (modules 1–5) translate to competency through beginning algebra; the STEM requirements (modules 1–9) are equivalent to competency through intermediate algebra; the career-technical education/vocational requirements (modules 1–3) translate to competency in arithmetic.
7. The variation in college-level math requirements for career-technical education/vocational pathways makes it challenging to perform this analysis for this subgroup.
8. All students who passed the STEM content on the VPT are counted as having placed into STEM college math, including students who planned to enroll in a liberal arts rather than a STEM program. All students who passed only the liberal arts content are counted as having placed into liberal arts math, including students who planned to enroll in a STEM program.
9. Among both cohorts, "crossover" and "double" enrollments occurred. For example, a student who planned to pursue liberal arts but placed into STEM college math could have taken a liberal arts math course rather than a STEM math course. In Figure 2, such a student would be counted in the liberal arts enrollment category (as well as once in the overall enrollment category). He or she could have also taken both kinds of courses. In Figure 2, the student would then be counted separately as having enrolled in liberal arts and in STEM math, but would be counted only once in the overall course enrollment category.
10. It is important to recognize that students who did not place into college-level math but who did complete such a course within one year are not counted as having completed one in the Figure 4 findings. Including such students yields higher completion rates: 14%, 21% (overall: fall 2010, fall 2012); 8%, 10% (liberal arts: fall 2010, fall 2012); 6%, 11% (STEM: fall 2010, fall 2012).

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