

Counting on Math Faculty

Examining the Role of Faculty and Instructional Practices in Students' Gateway Math Success

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Students' success in their first college-level math course – also known as gateway math – is critical for college completion as well as participation in the Science, Technology, Engineering, and Math (STEM) disciplines.¹ Additionally, community college students who successfully complete gateway math are fifty percent more likely than their peers to transfer to a four-year institution.² Yet, in community colleges and universities alike, gateway math has been a barrier to student progress and attainment, particularly among Black, Latine³, and Native American students.^{4,5,6}

Empirical research in higher education has not fully explored the potential levers for improving student success in college math courses, or other disciplines. Unlike K-12, where extensive empirical research has established the importance of classrooms and instructors on student learning and course success,⁷ empirical studies in higher education have mostly examined the role of student background characteristics on college course success including student demographics, high school grades and high school test scores.^{8,9} These findings may help colleges identify *who* to prioritize for support but do not provide insights on *how* to improve outcomes. To create a fuller understanding of the most important levers for creating equitable student success in gateway math, we study the contribution of different factors to student's course success, including faculty and their instructional practices, gateway math course characteristics, the high school a student attends, as well as students' prior academic preparation and demographics.

Study Findings

1. Math faculty are the most important factor in determining a student's successful completion of gateway math.
2. Specific instructional practices can reduce racial disparities in gateway math course outcomes.

This study includes 22,827 students in 704 transfer-level math courses taught by 159 California community college math faculty in winter 2020 to spring 2022 across four colleges.¹⁰ The four colleges in the study were selected because they enroll a racially diverse group of students and have a track record of working to improve both overall student success and eliminate racial disparities in gateway math. Additionally, the four colleges hail from a range of regions and settings (i.e., urban, rural, suburban), and vary in their size from small (~4,000 students) to large (~36,000 students).

Faculty Are the Most Important Determinant of Student Success in Gateway Math

We find that whether a student passes gateway math depends more on who they have as their faculty than any other factor examined. In other words, an individual faculty member's contribution to a student's likelihood of passing gateway math with a C or higher is larger than the contribution of any other factors including prior academic preparation, the high school a student attended, student demographics, and course attributes.

Factors Examined

Student Demographics: student's race/ethnicity, age, gender, eligibility for California College Promise Grant, disability status, and veteran status.

Prior Academic Preparation: student's high school GPA, as well as whether the student has taken a college-level gateway math course before.

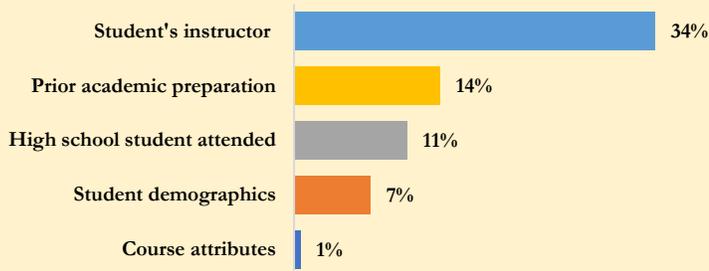
Prior High School(s): high school(s) attended by a student – potentially capturing the impact of high school quality, high school peer effects, and a student's socio-economic status.

Course Attributes: gateway math course type (i.e., Statistics, College Algebra, Precalculus, Quantitative Reasoning, and Gateway Math for Business); class size; and course length in weeks.

Student's Instructor: individual faculty teaching a student's gateway math.

Prior research has found that high school GPA is particularly predictive of student success in gateway math

Contribution of Each Factor to Passing a Gateway Math Course



Note: Percentages indicate the approximate contribution of the named set of factors (e.g., student's instructor) to the total variation in a student passing gateway math with a grade of C or higher that can be explained by the full model, after controlling for all other factors (e.g., student demographics, prior academic preparation, high school student attended, course attributes, college, and term). Percentages do not sum to 100 as the contributions of college and term are not conveyed in the figure.

Source: Authors' analysis of colleges' data.

courses. Similarly, we find that our measure of prior academic preparation, which includes high school GPA, is the second most important contributor to student success in gateway math, second only to gateway math faculty.¹¹ However, academic preparation is less than half as important in predicting whether a student passes gateway math with a C or higher compared with who they have as their gateway math faculty. The third most important factor is the high school students attend followed by students' demographic characteristics.

Individual faculty continue to be the most important determinant of course success when we consider different measures of course success, including course grade, passing with a B or higher, and not withdrawing from the course.¹²

Faculty Can Use Specific Instructional Practices to Reduce Racial Disparities in Gateway Math Outcomes

The racial equity gaps in our sample mirror those found in other studies.¹³ Among the four colleges studied, 44% of Black students and 48% of Latine students passed any gateway math course in our analysis compared with 67% of White students and 71% of Asian students. To offer actionable insights about ways to support student success overall and to reduce racial disparities in success rates, we examine how specific instructional practices are related with gateway math course success.

We developed a faculty survey which was administered to faculty during the Spring 2022 semester and analyzed faculty's course syllabi for the same semester.¹⁴ We then examined the relationship between instructional practices gleaned from the faculty survey and syllabi and student success while accounting for student and course characteristics.¹⁵

We find that the following instructional practices benefit one or more student groups, particularly Black and Latine students:

<p>Implementing growth-oriented and transparent assessment and grading practices</p>	<p>These practices include providing feedback to students on how to improve or offering opportunities to practice before exams and projects. Another aspect is transparency and clarity in the course syllabi about course expectations and grading criteria or showing solutions with work shown.</p> <p><i>These practices were positively associated with passing gateway math for Black, Latine, and Asian students.</i></p>
<p>Offering accommodations equitably</p>	<p>This practice involves recognizing that students face life challenges and may need accommodations. For example, the syllabus may offer accommodations for missed work due to unforeseen circumstances and make it clear when these accommodations are made. Equitable enforcement is an essential element of this practice. For example, faculty may take steps to inform all students when they make an exception to a stated policy. Such communication ensures that all students, not just those who know how to advocate for themselves, can benefit from extended deadlines and other exceptions.</p> <p><i>These practices were positively associated with passing gateway math for Black and Latine students.</i></p>
<p>Encouraging students to seek help and communicating support</p>	<p>Encouraging help seeking and supportive messaging includes destigmatizing the need for assistance and being clear about when it is a good idea to ask for help. For example, syllabi may include information outlining when a student should ask for help or clarify that coming to see the instructor is not a burden.</p> <p><i>These practices were positively associated with passing gateway math for Black students.</i></p>
<p>Fostering belonging</p>	<p>Fostering belonging includes creating intentional opportunities for students to connect with each other and work together. They may include faculty assuring students that concerns about belonging are normal and do not reflect inadequate academic potential. Finally, faculty may help students navigate college by sharing how to address faculty, location of office hours and lab, or what to include in an email to the instructor.</p> <p><i>These practices were positively associated with passing gateway math for Black students.</i></p>
<p>Taking responsibility for addressing racial equity</p>	<p>For example, a syllabus may include norms on how students should respect individual differences or provide guidelines for engaging in group work in ways that value diverse backgrounds.</p> <p><i>These practices were positively associated with passing gateway math for Black students.</i></p>

Given that the groups with the lowest pass rates in gateway math benefitted the most from these practices, these approaches have the potential to reduce racial disparities. These practices consistently advanced the success of Black students, followed by Latine students. Our findings align with previous research finding that interventions to improve students' sense of belonging and mitigate self-doubt about mathematics

improved grades and long-term academic outcomes for Black students, with no discernible impact on White students.^{16,17}

Implications

Years of reform in community college math, such as replacing long sequences of remedial courses with corequisite support and offering math that is relevant to students' majors, have increased and diversified students enrolling in and completing gateway math.^{18,19,20} Despite these important gains, gateway math courses continue to see overall low success rates and disparities in completion by race. This study's key findings about the significant impact of faculty and their instructional practices have important implications for how community colleges can improve equitable outcomes in gateway math to put more students on the path to college success, STEM participation, and college completion.

This research indicates that shifting away from assessing, sorting, and tracking students and toward resourcing and supporting faculty development may be a more powerful strategy for accelerating gateway math success and increasing equity in college outcomes. Possibilities include making disaggregated data on student success readily available to faculty and providing them high-quality professional development on implementation of evidence-based practices. Other opportunities involve compensating all faculty, including part-time instructors, for the time they spend in meetings, trainings, and other spaces where they receive or offer mentorship to peers. Faculty should also be front and center in research, policy, and practice work that examines and scales effective and equity-focused instructional practice.

More research is needed to dig deeper into the impact of faculty and their instructional practices on students' gateway math success. Specific areas for additional inquiry include the role of faculty race or prior faculty training on student success. In addition, more research is needed to understand the effect of instructional practices on student's college persistence and success. Importantly, research must also investigate the types of supports needed to help faculty adopt evidence-based instructional practices. Finally, future research should study and systematically document the institutional and state policies that create barriers to institutionalizing equitable math instruction and recommend approaches that facilitate faculty development and the adoption of practices that lead to equitable outcomes.

¹ Belfield, C.; Jenkins, D. & Fink, J. (2019). *Early Momentum Metrics: Leading Indicators for Community College Improvement*. Community College Research Center. <https://ccrc.tc.columbia.edu/publications/early-momentum-metrics-leading-indicators.html>

² Johnson, H. & Meija, M.; (2020). *Increasing community college transfers: Progress and barriers*. Public Policy Institute of California. <https://www.ppic.org/publication/increasing-community-college-transfers-progress-and-barriers/>

³ We use the terms Latine to describe people who come from, or have family roots coming from, countries in Latin America and the Caribbean. Other terms used in the research literature and public surveys include Hispanic, Latino, or Latinx.

⁴ Brathwaite, J., Fay, M., & Moussa, A. (2020, November 2). *Improving developmental and college-level mathematics: Prominent reforms and the need to address equity*. Community College Research Center. <https://ccrc.tc.columbia.edu/publications/improving-developmental-college-level-mathematics.html>

⁵ Park, E.S., Ngo, F. & Melguizo, T. *The role of math misalignment in the community college STEM pathway*. Research in Higher Education 62, 403–447 (2021). <https://doi.org/10.1007/s11162-020-09602-y>

- ⁶ Park, E. S., & Ngo, F. (2021). *The effect of developmental math on STEM participation in community college: Variation by race, gender, achievement, and aspiration*. *Educational Evaluation and Policy Analysis*, 43(1), 108–133. <https://doi.org/10.3102/0162373720973727>
- ⁷ Exceptions in higher education are single institution studies. A 1991 study at one university found that among students taking a Review of Economics course, instructors were the most important source of variation in student success (Watts & Bosshardt, 1991). Similarly, a recent study that focused on introductory statistics courses at one college found instructors played a bigger role in students’ success than student background or course characteristics (Newell & Sabawi, 2022).
- ⁸ Andrews, D. & Tolman, S. (2021). *Predictors of student academic success in the corequisite model*. (2019). *Georgia Journal of College Student Affairs* 37(2), 20-42.
- ⁹ Quarles, C; Budak, C.; Resnick, P. (2020). *The shape of education inequality*. *Science Advances*. Vol. 6; No. 29.
- ¹⁰ For more detail on methodology see full report.
- ¹¹ Scott-Clayton, J., Crosta, P. M., & Belfield, C. R. (2014). *Improving the targeting of treatment: Evidence from college remediation*. *Educational Evaluation and Policy Analysis*, 36(3), 371–393. <https://doi.org/10.3102/0162373713517935>
- ¹² See full report for detail on methodology and full results.
- ¹³ Bickerstaff et al. (2022). <https://postsecondaryreadiness.org/five-principles-for-reforming-developmental-education/>
- ¹⁴ A review of empirical and qualitative literature was used to identify promising instructional practices, which were then vetted by a practitioner and researcher advisory group. For more detail on the faculty survey and syllabi see the full paper.
- ¹⁵ Our full sample for Spring 2022 includes 3,695 students, enrolled in 185 gateway math courses, taught by 104 instructors. For survey analysis, we were able to match 2,884 students, enrolled in 137 gateway math courses, with 78 instructors who responded to the survey (the survey response rate was 75%). The survey analytic sample includes a total of 2,907 observations, unique by student and course. For syllabi analysis, we were able to match course syllabi to 150 gateway math courses, taught by 91 instructors, enrolling 3,029 students. The syllabi analytic sample includes a total of 3,046 observations, unique by student and course.
- ¹⁶ Brady, S.T., Cohen, G.L. Jarvis, S.N., & Walton, G.M. (2020). *A brief social-belonging intervention in college improves adult outcomes for Black Americans*. *Science Advances*.
- ¹⁷ Walton, G. M., & Cohen, G. L. (2007). *A question of belonging: Race, social fit, and achievement*. *Journal of Personality and Social Psychology*, 92(1), 8296. <https://doi.org/10.1037/0022-3514.92.1.82>
- ¹⁸ Brathwaite et al. (2020, November 2). <https://ccrc.tc.columbia.edu/publications/improving-developmental-college-level-mathematics.html>
- ¹⁹ Bickerstaff et al. (2022). <https://postsecondaryreadiness.org/five-principles-for-reforming-developmental-education/>
- ²⁰ Mejia et al. (2021). <https://www.ppic.org/publication/community-college-math-in-californias-new-era-of-student-access/>

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Education Equity Solutions (EES) conducts research and facilitates learning to drive equity-centered policy change in higher education. We work to ensure education policy is informed by a deep understanding of research evidence and grounded in the experiences of students and practitioners, especially those from systematically excluded communities.