Leading the Way

Cuyamaca College Transforms Math Remediation

"The data is clear that traditional placement and remediation strategies are failing the vast majority of California community college students. Through courageous conversations and leadership, Cuyamaca College transformed a challenging problem into meaningful action. The early results from this model provide a strong endorsement for implementing these and similar reforms across the system."

– Eloy Ortiz Oakley
Chancellor, California Community Colleges

THE CALIFORNIA ACCELERATION PROJECT SEPTEMBER 2017

www.AccelerationProject.org

The California Acceleration Project

The California Acceleration Project (CAP) was founded in 2010 by two community college teachers who wanted to do something about the poor outcomes of students placed into remediation. CAP is a faculty-led professional development network that supports the state's 114 community colleges with the goal of transforming remediation to increase college completion and equity. CAP colleges implement reforms that increase student completion of transferable, college-level English and math requirements, a critical milestone on the path to degrees and transfer. These reforms include using high school grades in placement, tailoring math remediation to a student's chosen program of study, replacing traditional remedial courses with corequisite support models, and teaching with high challenge, high support pedagogy.

Suggested Citation:

Henson, Leslie; Huntsman, Hal; Hern, Katie; and Snell, Myra. (September 2017). Leading the Way: Cuyamaca College Transforms Math Remediation. Sacramento, CA: The California Acceleration Project.

This publication was made possible through the generous support of the Bill & Melinda Gates Foundation, the James Irvine Foundation, the College Futures Foundation, and the William and Flora Hewlett Foundation through the California Education Policy Fund.

cepf CALIFORNIA EDUCATION POLICY FUND

The James Irvine Foundation

COLLEGE FUTURES FOUNDATION

Abstract

Cuyamaca College is the first community college in California to completely transform math remediation–from how it assesses and places students into math courses, to the courses it offers, to what happens in the classroom. Most students at Cuyamaca can now complete their math requirements in one semester. Students in math-intensive majors take no more than one semester of math that doesn't count toward a bachelor's degree. And math faculty are teaching with "brains-on" activities and collaborative pedagogy. The result? Completion of transferable, college-level math has increased nearly sevenfold among students who would have previously taken remedial courses, with dramatic gains for all racial and ethnic groups. Cuyamaca's experience points the way for the rest of the state, revealing what's possible when colleges step up to transform their systems on behalf of students.

In 2015, Cuyamaca College counselor Melanie Davidson had bad news for three out of every four new students she saw: They had scored low on the community college's placement test and would be required to spend up to two years rehashing K-12 math in classes that would not count toward a bachelor's degree. Davidson recalls how "discouraged and defeated" students felt. "Countless students gave up because of these requirements," she says.

Urgent Need for Reform

Each year in California, 170,000+ community college students start in remedial math. More than 110,000 never complete the math required for a degree.[i]

What's especially problematic is that students are being designated as "unprepared" and placed into remedial courses based on standardized tests that tell us virtually nothing about their academic capacity.[ii] And a growing body of research shows they are far more capable than previously recognized.[iii]

> "In its current form, developmental education may be one of the largest impediments to success in California's community colleges."[iv]
>
> – The Public Policy Institute of California

Students of color are hit the hardest by remedial requirements. They are more likely than white students to be assigned to remediation and required to take multiple remedial courses. With each remedial course required, their chance of completing a college degree drops.

Across the California Community Colleges, most black and Latinx students classified as "underprepared" must take three or more remedial math courses.[v] Among students required to spend this much time in remediation, fewer than 10 percent will go on to complete the math for a bachelor's degree.[vi] A recent study estimated that 50 to 60 percent of racial achievement gaps in completion of degrees, certificates, and transfers to four-year colleges and universities are explained by students' initial placement into English and math courses.[vii]

The Math Pathway Transformation

Cuyamaca College faculty are leaders in a grassroots movement to transform remediation across the California Community Colleges. In 2011, they were among the first to offer an accelerated statistics pathway as part of the California Acceleration Project (CAP), a professional development network focused on redesigning remediation.[viii] The college's pre-statistics course, which provided an alternative to the traditional algebra sequence for students in non-math-intensive majors, not only increased student completion of college math—it tripled student completion of degrees, certificates, and transfer.[ix]

This early success emboldened Cuyamaca faculty members. They wanted to help even more students complete college math and go on to earn degrees and certificates and to transfer to four-year schools. They wanted to "annihilate the achievement gap." In spring 2015, faculty member Terrie Nichols attended a CAP Next Steps event for colleges that had already had success in implementing accelerated developmental courses. The event presented national research on the most powerful strategies for transforming remediation and reducing achievement gaps,[x] including using high school grades for placement and replacing traditional remedial courses with corequisite support at the baccalaureate level. When Nichols brought these ideas back to her colleagues, they decided to go all in.

"We saw that it was possible," reflected math department chair Tammi Marshall. "We didn't want to be sitting here, five years down the road, without having at least tried. The cost to the students is too great not to do something."

Karly Franz, Pre-Calculus with Support

Five years away from high school, Franz's math skills were rusty. The college placement test determined she should repeat her high school Algebra 2 course, but Cuyamaca's new placement policy enabled her to advance into pre-calculus with corequisite support. Karly enjoyed the course's intensity and, despite challenges outside the classroom, earned a B+. She's now on her way to her dream of becoming a high school biology teacher.

In fall 2016, Cuyamaca launched its new Math Pathway program, with different math pathways for students pursuing different majors. The college made three big changes:

<u>Change #1:</u> Recognize students' high school work in course placement

<u>Change #2:</u> Replace one-size-fits-all remedial courses with math pathways where underprepared students enroll directly in transfer-level courses with tailored corequisite support

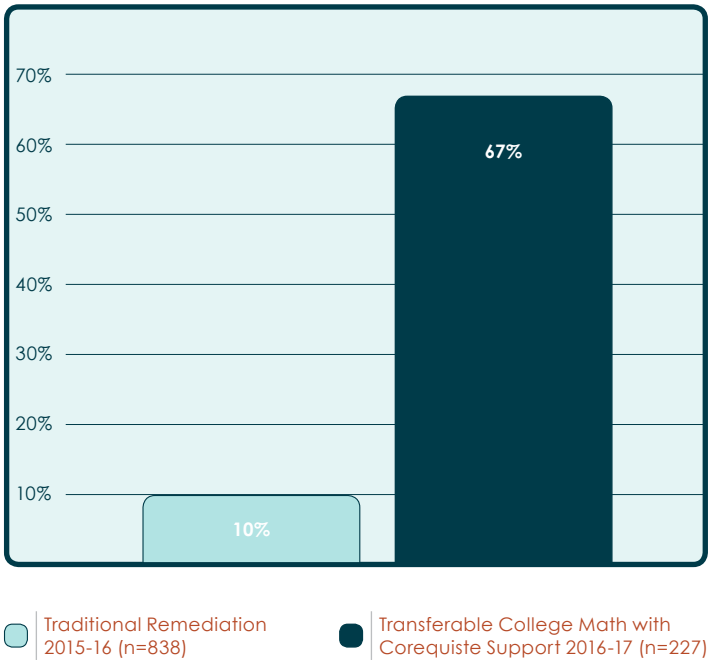
<u>Change #3:</u> Teach math through "brains-on" activities in a collaborative, community-oriented space with attention to the affective side of learning

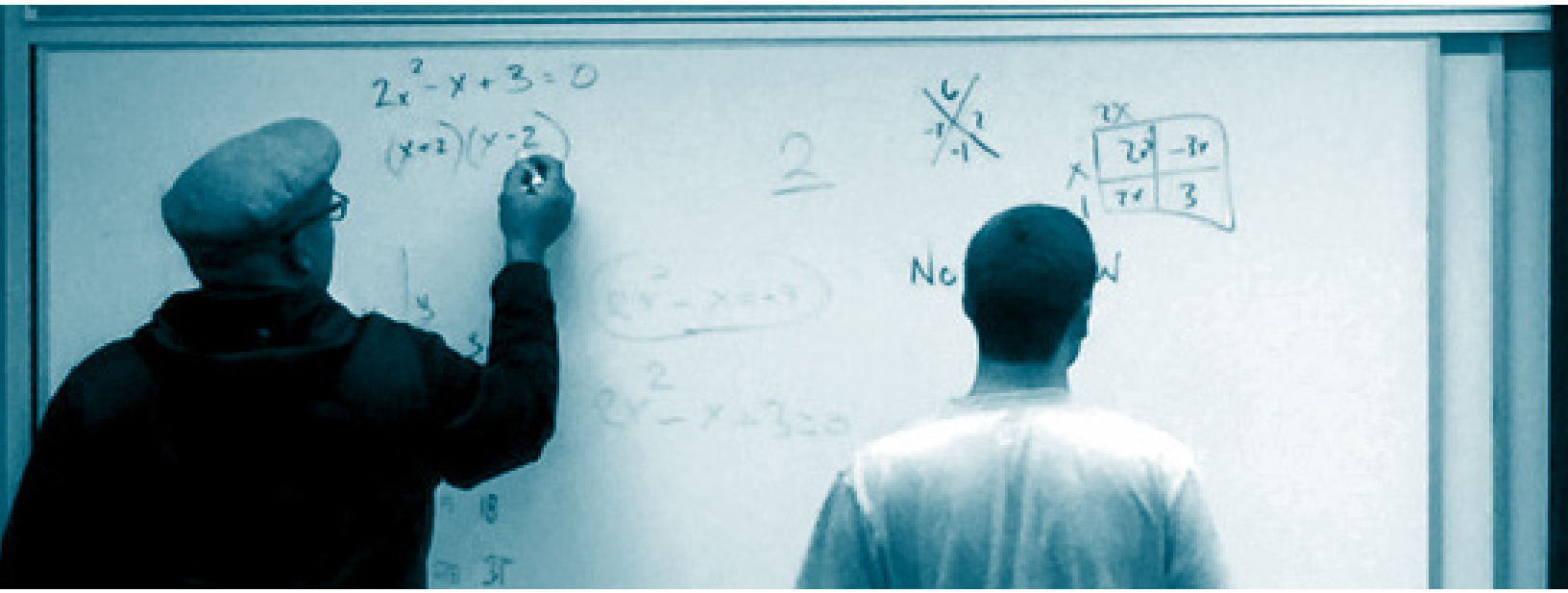
The results illustrate what's possible when colleges transform remediation. In 2016-17, underprepared students' completion of baccalaureate-level math[1] was almost seven times higher than the previous year (Figure 1). Among first-time students in the corequisite support classes, completion was dramatically higher than in traditional remediation across all of the new math pathways and for all racial and ethnic groups:

- six times higher for students in business and STEM pathways (science, technology, engineering, and math) (from 10% to 59%);
- seven times higher for students taking statistics for their pathway (from 10% to 69%);
- four times higher for Latinx students (from 15% to 65%);
- five times higher for white students (from 16% to 76%); and
- nine times higher for black students (from 6% to 55%).

Thanks to the new program, counselor Davidson says she can now deliver the news that "there is a pathway for all students to complete their goals."

Figure 1: Completion of Transferable College Math Within One Year for Underprepared Students





[1] Throughout, we use "baccalaureate-level math" and "transferable college math" interchangeably to mean math courses that count for credit toward bachelors' degrees.

Change #1: Recognize students' high school work in course placement

Instead of relying primarily on placement test results to determine where students should start math in college, Cuyamaca now recognizes students for taking algebra and having a good GPA in high school. Studies have shown that such "multiple measures" are much more predictive of students' ability to succeed in college than one-shot standardized tests.[xi]

When Cuyamaca students take their assessment tests, they now answer a series of questions about their high school GPA, math courses taken, and math grades earned. Their course placement is then determined by whichever measure places them higher—their test results or their high school GPA and math coursework.

Under the new policies, every student is eligible to start in college statistics with corequisite support, and 62 percent of students can begin in transferable, college-level math courses in business/STEM fields— either in standard sections, or in sections with additional support attached.[2] The remaining business/STEM students have only one semester of remediation. They start in intermediate algebra, standard or with support.

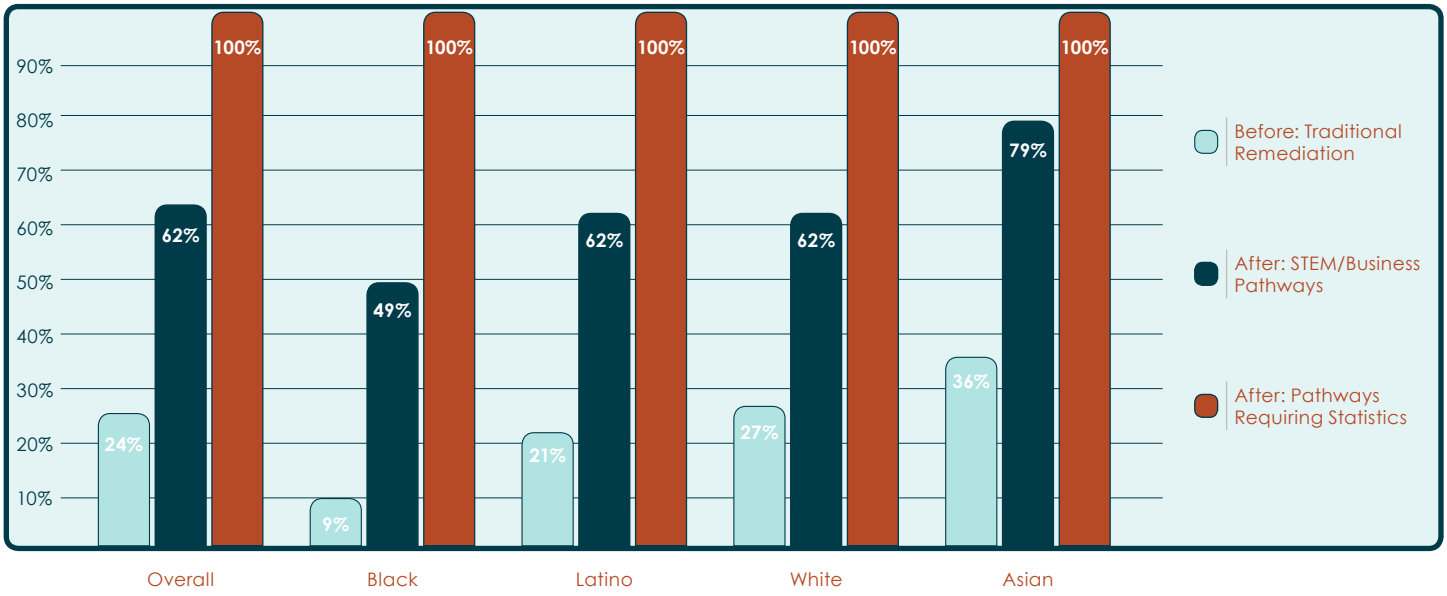
Students of color have particularly benefited from these changes. Under the college's previous use of standardized placement tests, black and Latinx students were disproportionately tracked into remedial coursework. Compared to fall 2015, Latinx students' access to baccalaureate-level courses is three times higher in business and STEM math courses, five times higher in statistics. Black students' access is five times higher in business and STEM, 11 times higher in statistics (Figure 2).

Importantly, students are showing they are up to the challenge of higher-level work. Even though many more students are bypassing remediation, success rates in baccalaureate-level courses have held steady, and the majority of students previously classified as "underprepared" are successfully completing these courses (Figure 3).

The results spotlight just how ineffective the prior placement policy had been (Figure 3). Take students who, according to the placement test, needed two semesters of remedial courses. When allowed to enroll directly in baccalaureate-level math with support, they passed at a rate of 70 percent. Even students with the lowest test scores—those who previously would have had to take three or more remedial courses— passed the baccalaureate-level course at a rate of 56 percent, a completion rate 14 times higher than among students who began in the traditional remedial sequence.

"When you think about it, it makes sense," says Marshall, the math department chair. "Success in past coursework is a much better predictor of success in future coursework than any one-time, high-stakes test could ever be."

Figure 2: Students Eligible for Transferable College-Level Math Before and After Math Pathways



[2] Placement differs by pathway because students taking math courses for business/STEM fields will need more preparation in algebra than will students taking college statistics. College statistics is the terminal math course for most programs in general education and career and technical education pathways.

Change #2: Replace one-size-fits-all remedial courses with math pathways, where underprepared students enroll in transfer-level courses with tailored corequisite support

Rather than continuing to force students to repeat high school courses, Cuyamaca faculty decided to allow students to review the knowledge and skills from those courses "just in time"—when they come up in the context of more advanced material.

Cuyamaca replaced its traditional stand-alone remedial courses with two-unit corequisite support courses that are paired with transferable college math courses and taught by the same instructor. There are five math pathways, and students are advised to choose the one that makes the most sense for their intended majors:

- General education
- Education
- Career technical education
- Business
- STEM

For the most underprepared students in math-intensive majors, a three-unit support course is paired with intermediate algebra, which means taking a single semester of math that does not count toward a bachelor's degree. The college also continues to offer its one semester pre-statistics course, but it is optional; any student can enroll directly in college statistics with two units of corequisite support.

One year in, faculty say they are enjoying teaching in the new pathways. "Students are more motivated to learn because these courses get them to their goals more quickly," says Vi Trang, who teaches the course Business Calculus with Support.

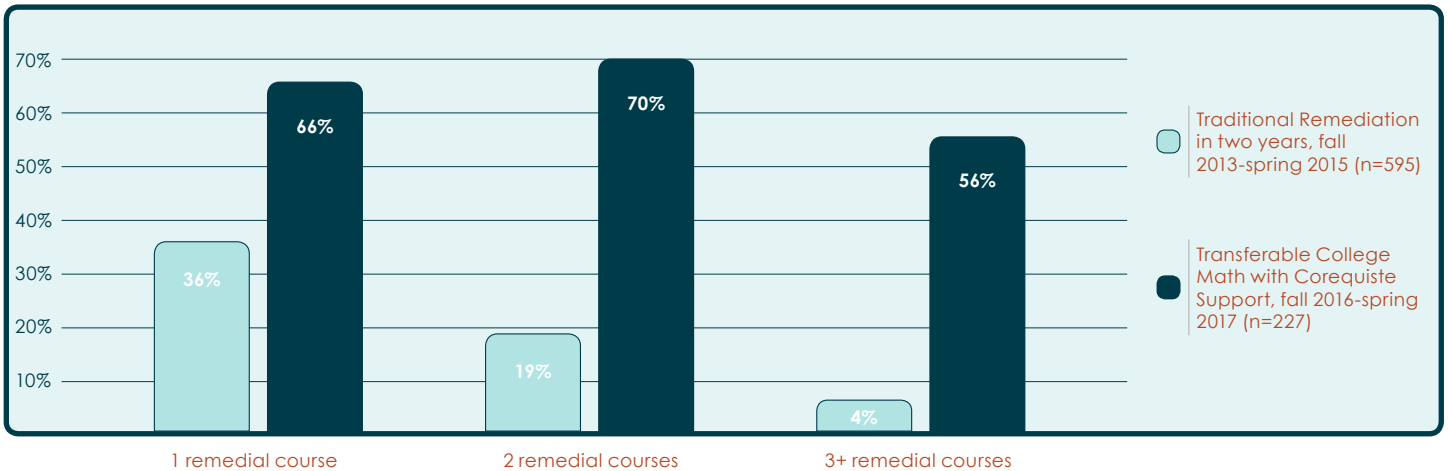
To ensure that students are prepared to tackle rigorous work, Math Pathway teachers think carefully about the prerequisite skills students will need to understand baccalaureate-level concepts, and they build those skills into the more advanced material.

> "The students know more than you think they do, and they can do more on their own than you think."
>
> – Professor Chris Navo
> College Algebra with Support.

For example, in Annalinda Arroyo's College Statistics with Support course, students examine a dataset to determine if there is a relationship between a student's GPA and the number of hours studied per week. Based on what they find out, Arroyo then might ask students to estimate how many hours of study are needed for a particular GPA, like a 3.5, that is not part of the dataset. Students' desire to make accurate predictions leads them to learn a statistical technique, "linear regression," and a related mathematical concept called "rate of change." Students are then motivated to work through a "math interlude" on interpreting rates because they realize it will help them understand the more advanced concept of linear regression.

Math Pathway teachers at Cuyamaca say that underlying the corequisite model is a belief in students' capacity. "We shouldn't limit students just because they have a label like 'underprepared,'" says Arroyo, who has taught both Intermediate Algebra with Support and Statistics with Support. "When students want to answer questions, they will learn the skills they need to answer them."

Figure 3: Students Completing Transferable College Math by Placement Test Results



Window into the Classroom
College Statistics with Support

College statistics is the baccalaureate-level math course taken by students in most majors. Traditional remediation does a poor job of preparing students for statistics, because few of the topics covered in the year-long algebra sequence are needed for success in the course. In the course College Statistics with Support, faculty can focus on the skills and concepts most relevant to the study of statistics.

In the Statistics with Support course, Terrie Nichols' students are tackling a hard topic: conditional probability. The lesson begins with students in small groups working to read a contingency table. This is not something Nichols would have time for, or really need, in her stand-alone statistics course, but interpreting this table is an essential first step to constructing useful probability estimates. The table contains data from the World Health Organization and the United Nations, and the context is sophisticated: countries are categorized as high, medium, or low in cancer mortality and as above or below average in per capita supply of animal protein. When the whole class is called back together, Nichols starts a low-stakes quiz where random students must answer questions on behalf of the class. How many countries have a high cancer mortality rate? What does the 32 represent in the table? When Nichols is satisfied with the class' progress, she poses a question that leads to a discussion of conditional probability: Is higher animal protein supply associated with higher cancer mortality rates? This method allows the class to transition from remedial support to college-level work. Next, students are back in groups grappling with new sets of data. "Does playing soccer increase the risk of arthritis?" Nichols checks in with each group, occasionally intervening with a question or two to nudge students in the right direction. A student has a question about rounding percentages; his group reminds him how this is done. Nichols nods and moves on. She makes a note to check in with this student later. Students are focused, anticipating the next time they'll have to present a solution at the board or take a whole class quiz. "Unlike other math classes I have taken, this class is not about passing; it's about learning," says Statistics with Support student Cristal Balk. "I learned way more math than ever before."

Caleb Rendon-Guerrero, College Statistics with Support

Rendon-Guerrero spent several years in gangs and was in and out of the criminal justice system before coming to college. He says he wants "to be the solution, not the problem" in his family. According to his community college placement test, he needed a year of algebra courses before enrolling in statistics. Instead, he began directly in College Statistics with Support and earned a B. His goal is to get a bachelor's degree, likely in sociology, and open a nonprofit that helps students like him.

Change #3: Teach math through "brains-on" activities in a collaborative, community-oriented space with attention to the affective side of learning

In its work with CAP, the Cuyamaca math department had adopted a set of shared instructional design principles. These principles stress that, instead of the traditional paradigm of drilling students on decontextualized remedial skills, underprepared students should be engaged in rigorous college-level work, with "just-in-time remediation" as needed. Students should reason their way through relevant, open-ended problems in a collaborative and supportive classroom environment.[xii] Educational research shows that this kind of high-challenge, high-support pedagogy promotes learning and retention, especially for students of color and other traditionally underserved populations.[xiii]

The faculty wanted to promote a community of learners willing to make mistakes and support each other's growth. Instead of treating struggle as a sign of failure, teachers wanted students to see struggle as a sign of learning.

> "Students are more engaged and involved than I've ever seen before. Students also have mathematical discussions with each other at a much deeper level than I have experienced."
>
> – Professor Glenn Creswell,
> Pre-Calculus with Support

This kind of pedagogy represents a substantial shift for many instructors in the math department. "When I was in school, I was lectured to," says Intermediate Algebra with Support teacher Rachel Krajewski. "I wrote down everything the teacher said and went home to make sense of it by myself."

Just like their students, faculty have had "to get comfortable being experimental and to stop worrying about failing," says Glenn Creswell, who teaches Pre-Calculus with Support. To help teachers make this shift, Cuyamaca has sent faculty to CAP's statewide community of practice, and they meet every other week in a local community of practice.

The department has also developed a set of common classroom activities for each corequisite support course, including "math interludes," where more basic math skills and concepts are reviewed in the context of the higher-level work. These activities keep students on their toes—often literally working on problems at the classroom's whiteboard. "I used to be at the board around 80 percent of the time," says Scott Eckert, who teaches Intermediate Algebra with Support. "Now, I'm at the board 20 to 30 percent of the time."

> "This class is very different from other math classes I have taken. We help each other. We share answers and approaches. It helps people who are shy and afraid to ask for help."
>
> – Student Lizbeth Bueno,
> Intermediate Algebra with Support

To promote community and prepare students for tests, instructors use collaborative activities like the Whole Class Quiz. Groups of three or four students are given separate problems on notecards and told to solve them on the whiteboards positioned around the room. Since everyone in the class receives the same grade for this low-stakes quiz, groups are allowed to critique or offer suggestions to each other, but only members of the group can physically alter their solutions. After debate has died down, the instructor moves around the room, grading each problem. This provides a learning opportunity in that moment and demonstrates explicitly the teacher's expectations. By the time students are tested individually, they know what they need to do and how they'll be evaluated.

Cuyamaca faculty also integrate activities that "help students change their perspective about education and about their own ability to succeed," says Business Calculus with Support instructor Trang. These activities represent the CAP design principle of intentional support for the affective side of learning.

CAP trainings emphasize that when students aren't successful in their classes, the core issue is often not their ability to handle the course content. When they encounter a difficult task, or receive critical feedback, or start to feel hopeless, many capable students will withdraw effort and even disappear from class.[xiv]

In another activity called Strange Choices, Cuyamaca instructors ask students to read scenarios about students whose behaviors undercut their learning, such as arriving late to class every day, never turning in assignments, not speaking in class even though they are graded on participation, or dropping a class with only two weeks left in the term. The instructor has the students in class try to explain the choices the students are making and problem-solve some better choices. The resulting discussion is an opportunity for students to reflect on their own choices and for teachers to better understand students' perspectives and how they can help. For homework, students respond to the prompt: "Recall a math course (or any course) where you made a choice that your instructor might describe as 'strange.' Explain why you made that choice. Dive deep, explore what really caused your choice—what feeling, emotions, past experiences, or internal message."

Students seem to prefer this kind of classroom to a traditional math class. In an electronic survey sent to all students enrolled in a course with support and those in the same course taught in the traditional mode, corequisite students were more likely to feel comfortable making mistakes in class, agree that their course provided them with more opportunities to receive guidance from other students, believe the instructor did a good job of managing the classroom, and think the in-class activities helped them master the course material.

Beyond helping students learn math, Math Pathway teachers believe they are filling a larger societal need. "I am developing researchers," says Arroyo. "In real life, there are no clear paths to the answers. I'm trying to teach the analysis and deep thought that find those answers."

Michael Smith, College Statistics with Support

Smith served for 20 years in the United States Navy before coming to Cuyamaca for certifications as an executive assistant and a realtor. Though he hadn't studied math since high school in the 1980s, he was able to complete his math requirements in one semester instead of the two years it would have taken in the traditional remedial sequence.

Window into the Classroom
College Algebra with Support

College algebra (sometimes known as pre-calculus) is the first in a series of transferable college-level requirements for students in STEM majors, so it is a crucial gateway course.

Professor Chris Navo shows a 90-second video of Felix Baumgartner breaking the sky diving world record. Jumping from a height of over 40,000 meters above the earth, Baumgartner was in free fall for more than four minutes. After the video, Navo displays Baumgartner's heights at various times during his descent. In groups, students use the data to construct mathematical models to predict his height over time. Drawing on previous knowledge, most students develop linear models, and this provides an opportunity for students to review important concepts associated with constant rates of change. However, as students present and compare their work to see which models make the best predictions, they realize that linear models do not do a good job of predicting heights during both free fall and parachute use. This motivates the introduction of more sophisticated mathematical functions that are better at modeling this situation. The investigation continues as students grapple with the impact of changing parameters in these new equations to model different phenomena. Navo says this kind of exploration takes more time than traditional lecturing, but the resulting understanding is much greater. It allows students to enter the process where they are able, working together in community to shore up gaps in their knowledge or skills. "This reaches people," reflects Navo. "They learn from each other, and I help when the groups are stuck. The need for more basic skills comes up in the context of modeling a real situation."

"The changes we made were not expensive. We simply asked students to report their high school grades when they took the assessment test. Research shows that students' answers are reliable, and our results prove that this approach produces dramatic improvements in math completion."

– Julianna Barnes,
Cuyamaca College President

Looking Ahead: Implications for California

Cuyamaca College math faculty are the cliff jumpers of the CAP network. They were the first community college in California to overhaul placement, eliminate the traditional one-size-fits-all remedial sequence, and allow underprepared students to enroll directly in baccalaureate-level classes for their majors, with well-tailored corequisite support. While most colleges dip their toes into reform, Cuyamaca leaped.

What the math department did was bold, but it wasn't rash. In fact, it was supported by a large body of national evidence. In the field of higher education, we know high school grades are better indicators of students' performance in college than standardized placement tests.[xv] We know math pathways and corequisite models are much more effective than traditional remediation,[xvi] and that students with the lowest test scores see the biggest gains.[xvii] We know traditional remediation has been massively underestimating students,[xviii] and that it has derailed far too many students' college dreams.[xix]

What makes Cuyamaca different is that it was willing to act on this knowledge. Its success points the way for the rest of us and, frankly, throws down the gauntlet.

Every community college in California can do what Cuyamaca did. The structural changes require substantial front-end work: creating new placement policies, designing new corequisite support courses, transforming the class schedule, working closely with the informational technology department to ensure that students can easily register for the linked support courses. And the pedagogical changes require ongoing support for faculty, including regular opportunities for teachers to meet and well-designed curricular materials they can use in class.

It's a lot of work, but it's doable.

What's more, our four-year partners have cleared policy obstacles that had previously impeded reform. The California State University no longer requires that all transfer students complete an intermediate algebra prerequisite, and the University of California allows alternative preparation for statistics. In short, we can no longer point to CSU and UC to defend our inaction.

Other states have already made the changes Cuyamaca made. When Tennessee replaced traditional remediation with corequisite support models, community college students' completion of college math classes quadrupled statewide and was seven times higher for minority students.[xx] Corequisite models have also produced dramatic completion gains in the West Virginia, Georgia, Colorado, and Indiana community college systems.[xxi]

It's time for California to catch up. Our students deserve more. As Cuyamaca's President Julianna Barnes wrote in an op-ed for Capitol Weekly, "Students' chances of completing college should not depend on living within driving range of Cuyamaca College."

With hope for the future,

Katie Hern and Myra Snell
Co-founders of the California Acceleration Project

References

[i] Student Success Scorecard, 2017, Statewide. Sacramento, CA: California Community College's Chancellor's Office. Retrieved from http://scorecard.cccco.edu/scorecardrates.aspx?CollegeID=000#home

[ii] Belfield, C., & Crosta, P. (2012). Predicting success in college: The importance of placement tests and high school transcripts. New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from http://ccrc.tc.columbia.edu/publications/predicting-success-placement-tests-transcripts.html

Hern, K. (2015). Some college students more prepared than placement tests indicate. Oakland, CA: Ed Source. Retrieved from https://edsource.org/2015/some-college-students-more-prepared-than-placement-tests-indicate/90418

Scott-Clayton, J. (2012). Do high-stakes placement exams predict college success? New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from http://ccrc.tc.columbia.edu/publications/high-stakes-placement-exams-predict.html

[iii] Complete College America. (2016). Co-requisite remediation: Spanning the completion divide – breakthrough results fulfilling the promise of college access for underprepared students. Retrieved from http://completecollege.org/spanningthedivide/#the-bridge-builders

Hayward, C., & Willett, T. (2014). Curricular redesign and gatekeeper completion: A multi-college evaluation of the California Acceleration Project. San Rafael, CA: The Research and Planning Group. Retrieved from https://rpgroup.org/Portals/0/Documents/Projects/California%20Acceleration%20Project%20%28CAP%29%20Evaluation/CAP_Report_Final_June2014v2%20%28002%29.pdf

Henson, L., Hern, K., & Snell, M. (March 2017). Up to the challenge: Community colleges expand access to college-level courses. Sacramento, CA: The California Acceleration Project. Retrieved from http://accelerationproject.org/Publications/ctl/ArticleView/mid/654/articleId/56/Up-to-the-Challenge-Community-Colleges-Expand-Access-to-College-Level-Courses

Huntsman, H., Hern, K., & Snell, M. (October 2016). Capacity unleashed: The faces of community college math pathways. Sacramento, CA: The California Acceleration Project. Retrieved from http://accelerationproject.org/Publications/ctl/ArticleView/mid/654/articleId/53/Capacity-Unleashed-The-Faces-of-Community-College-Math-Pathways

[iv] Mejia, M.C., Rodriguez, O., & Johnson, H. (November 2016). Preparing students for success in California's community colleges. San Francisco, CA: Public Policy Institute of California. Retrieved from http://www.ppic.org/publication/preparing-students-for-success-in-californias-community-colleges/

[v] Perry, M., Bahr, P. R., Rosin, M., & Woodward, K. M. (2010). Course-taking patterns, policies, and practices in developmental education in the California Community Colleges. Mountain View, CA: EdSource. Retrieved from http://edsource.org/wp-content/publications/FULL-CC-DevelopmentalCoursetaking.pdf

[vi] Basic Skills Cohort Tracker. Management Information Systems Data Mart. California Community Colleges Chancellor's Office. Statewide report, Fall 2009-Spring 2012. Retrieved from http://datamart.cccco.edu/Outcomes/BasicSkills_Cohort_Tracker.aspx

[vii] Stoup, G. (October 2015). Using data to identify emergent inequities and the effective practices to address them. Presentation delivered at Success and Equity: Regional Conference for Collaboration. Modesto Junior College.

[viii] Hern, K. with Snell, M. (2010). Exponential attrition and the promise of acceleration in developmental English and math. San Rafael, CA: The Research and Planning Group. Retrieved from https://rpgroup.org/Communicating-Research-Findings/accelerated-developmental-english-and-math

Hern, K. with Snell, M. (2014). California Acceleration Project: Redesigning developmental education to increase student completion of college-level math and English. In New Directions in Community Colleges 2014 (167), 27-39. Eds. Hughes, K., & Venezia, A. Pre-publication manuscript retrieved from http://accelerationproject.org/Portals/0/Documents/Ch%203%20Hern%20Snell%20March%202014%20final%20pre%20pub.pdf?ver=2016-04-13-113026-087

[ix] Cuyamaca College Institutional Research. (2017). Math tables and summaries spring 2017 (Unpublished internal report). El Cajon, CA: Cuyamaca College.

[x] California Acceleration Project (August 2015). Acceleration strategies that produce powerful results: A planning resource for Community Colleges. Retrieved from http://accelerationproject.org/Publications/ctl/ArticleView/mid/654/articleId/7/Acceleration-Strategies-that-Produce-Powerful-Results

[xi] Scott-Clayton, J., & Stacey, G.W. (2015). Improving the accuracy of remedial placement. New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from http://67.205.94.182/publications/improving-accuracy-remedial-placement.html

See also Belfield & Crosta (2012) and Hern (2015), cited in ii.

[xii] Hern, K. with Snell, M. (2013). Toward a vision of accelerated curriculum & pedagogy. Oakland, CA: Learning Works. Retrieved from http://www.learningworksca.org/wp-content/uploads/2012/02/AcceleratingCurriculum_508.pdf

[xiii] Center for Community College Student Engagement. (2014). Aspirations to achievement: Men of color and community colleges. (A special report from the Center for Community College Student Engagement). Austin, TX: The University of Texas at Austin, Program in Higher Education Leadership. Retrieved from https://www.ccsse.org/docs/MoC_Special_Report.pdf

Edgecombe, N. (2011). Accelerating the achievement of students referred to developmental education. CCRC brief No. 55. New York, NY: Community College Research Center, Teachers College. Columbia University. Retrieved from http://ccrc.tc.columbia.edu/media/k2/attachments/accelerating-academic-achievement-students.pdf

Gay, G. (2010). Culturally responsive teaching: Theory, research, and practice. New York: Teacher's College, Columbia University.

George, P. G. (1994). The effectiveness of cooperative learning strategies in multicultural university classrooms. Journal on Excellence in College Teaching, 5(I), 21. Retrieved from https://pdfs.semanticscholar.org/4b0b/a6315f45729b23f4b4f2268d102b02c51548.pdf

Wood, J. L., & Palmer, R.T. (2014) Black men in higher education: A guide to ensuring success. New York, NY: Routledge.

[xiv] California Acceleration Project (2016). Attending to the affective domain. Retrieved from http://accelerationproject.org/Portals/0/Documents/Summary%20Affective%20Practices%20Oct%202016.pdf

[xv] Belfield & Crosta (2012), Hern (2015), and Scott-Clayton (2012 and 2015), cited in ii and xi.

[xvi] Hayward & Willett (2014), cited in iii.

Hoang, H., Huang, M., Sulcer, B., & Suleyman, Y. (2017). Carnegie Math Pathways 2015-2016 impact report: A five-year review. Stanford, CA: Carnegie Foundation for the Advancement of Teaching. Retrieved from https://www.carnegiefoundation.org/resources/publications/carnegie-math-pathways-2015-2016-impact-report-a-five-year-review/

Getz, A., & Ortiz, H.R. with Hartzler, R., & Leahy, F. (2016). The case for mathematics pathways. Austin, TX: Dana Center Mathematics Pathways. Retrieved from https://dcmathpathways.org/sites/default/files/resources/2016-11/The%20Case%20for%20Mathematics%20Pathways.pdf

[xvii] Complete College America (2016), cited in iii, and Office of the Vice Chancellor of Academic Affairs. (2016). Co-requisite remediation full implementation 2015-2016. Tennessee Board of Regents. Retrieved from http://www.aacc.nche.edu/Resources/aaccprograms/pathways/Documents/TNBoardRegents_FullImplementation2015-2016.pdf

Logue, A.W., Watanabe-Rose. M., & Douglas, D. (2016). Should students assessed as needing remedial mathematics take college-level quantitative courses instead? A randomized controlled trial. Educational Evaluation and Policy Analysis Month 201X, Vol. XX, No. X, pp.1-21. Retrieved from http://www.aera.net/Newsroom/Recent-AERA-Research/Should-Students-Assessed-as-Needing-Remedial-Mathematics-Take-College-Level-Quantitative-Courses-Instead-A-Randomized-Controlled-Trial

[xviii] Henson (2017), cited in iii, and Scott-Clayton (2012), cited in ii.

[xix] Bailey, T., Jeong, D.W., & Cho, S. (2009). Referral, enrollment, and completion in developmental education sequences in community colleges. New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from http://ccrc.tc.columbia.edu/publications/referral-enrollment-completion-developmental-education.html

[xx] Office of the Vice Chancellor (2016), cited in xvii.

[xxi] Complete College America (2016), cited in iii.

Cuyamaca's Math Transformation

Traditional Remediation	Math Pathways
Places students in math courses based on a single test, which most students take without advance preparation.	Uses high school grades, coursework, and GPA to place students in math courses; students are not required to repeat material they passed in high school.
Requires underprepared students to take up to two years of courses that rehash K-12 math before taking math that counts toward a bachelor's degree.	Most underprepared students begin directly in baccalaureate-level math with additional corequisite support from the instructor; business/STEM students take a maximum of one semester of pre-baccalaureate algebra.
One size-fits-all remediation: Underprepared students repeat high school algebra regardless of whether they need it for their majors.	Pathways approach: Underprepared students receive support tailored to the math in their programs of study (General education, business, STEM, education, career technical education).
Teachers lecture on the material or demonstrate problems on the board while students take notes.	Students do "brains-on" activities that help them grapple with important concepts in a community of learners, with guidance from their teachers.
75% of students must begin in remedial courses that don't count toward a bachelor's degree.	100% of students can start in college statistics with corequisite support; 62% in baccalaureate-level business/ STEM math with support.
10% of underprepared students who begin in remedial math courses complete a baccalaureate-level course within a year.	67% of underprepared students who begin in baccalaureate-level math with corequisite support complete the course within a year.