PROJECT EMBER
Developmental Education Reform

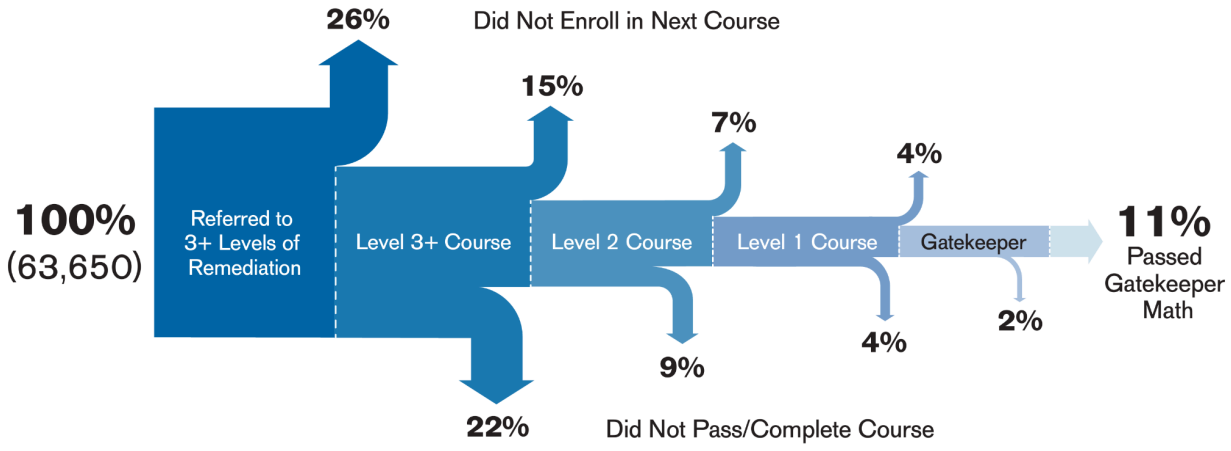
What is the Challenge? [in the eyes of an R1]

- Many colleges have set up a number of developmental mathematics courses to help students gain mathematical skills, but needing to take a sequence of prerequisite mathematics courses is a barrier to students' course-taking for their major, resulting in a longer path than many students succeed in navigating.
- Not all students entering college are positioned through their past opportunities to be successful in an introductory college mathematics course (college algebra or beyond) required by their intended major. By defaulting students into pathways that were meant to prepare students for Calculus, a large number of students enroll in math courses that are neither engaging nor relevant.

Why Does This Matter?

> ***"Our developmental mathematics system is a shell game, disproportionately scamming Black, Latino and poor students." (Larnell, 2020).***

The lower the initial developmental mathematics course placement, the less likely it is for students to eventually pass a college-level gatekeeper mathematics course [Figure from Jaggars & Stacey, 2014]. Not only does mathematics stand as a barrier for students achieving their post-secondary career goals, but this barrier disproportionately is higher for those already underrepresented in STEM.



What is Developmental Education Reform?

Developmental education reform comprises efforts to improve student success in developmental mathematics, including:

- minimizing the number of developmental courses students need to take before moving to credit-bearing courses

- supporting students' mathematical learning in credit-bearing introductory courses by coupling a support course to assist students' development of the skills and knowledge needed for the credit-bearing course (corequisites)
- providing alternative pathways for students beyond STEM pathways in support of emphasizing more meaningful content, such as quantitative reasoning and statistics, that would better serve students for their field of study and career.

Overview [click to read a brief history and timeline of developmental math reforms]
In Fall 2015, there were over six million full-time or part-time students enrolled in community colleges, which accounted for 43% of all undergraduate students enrolled in public U.S. institutions of higher education (Snyder, de Brey, & Dillow, 2018). Unfortunately, when we consider completion of a bachelor degree as a goal for many students who attend a community college, the data show that less than 16% of students who started at a community college in 2012 completed a degree at a four-year institution within six years (Jaggars & Stacey, 2014). Mathematics is widely viewed as one of the primary barriers that contributes to this abysmal completion rate. As an attempt to address this challenge, the Governor of California signed a bill that took effect in 2018 which dramatically changed the way students were placed into English and mathematics courses in California's community colleges. This bill, known as AB 705, required that community colleges in California provide maximum opportunity for students to complete college-level coursework within one year. As a follow-up, AB 1705 was signed into law by California's Governor in 2022 to fully support the comprehensive implementation of AB 705 and to address the remaining equity gaps and ensure that course placement systems were designed for equitable placement and successful course completion.

The most prolonged and pervasive challenge that community colleges are facing relative to mathematics is the extremely low student success, persistence, and throughput rates, where courses unfortunately serve more as leaky pipes than primed pumps in preparing and advancing students through mathematics. Blair, Kirkman, and Maxwell (2018) found that almost 41% of the 6 million community college students were enrolled in developmental mathematics courses. When researching student success in developmental mathematics at community colleges, Jaggars and Stacey (2014) shockingly found that only 11% of the 63,650 students in their study successfully passed the college-level introductory algebra (gatekeeper) course after completing three or more developmental mathematics courses (see Figure 1). This extremely low throughput rate is exacerbated by the low persistence rate of students exiting the three-course developmental sequence, where almost 25% failed to persist to the college-level gatekeeper course. Figure 1 below illustrates this leaky pipeline of developmental mathematics students. The lower the initial developmental mathematics course placement, the less likely it is for the student to eventually pass the college-level gatekeeper mathematics course.

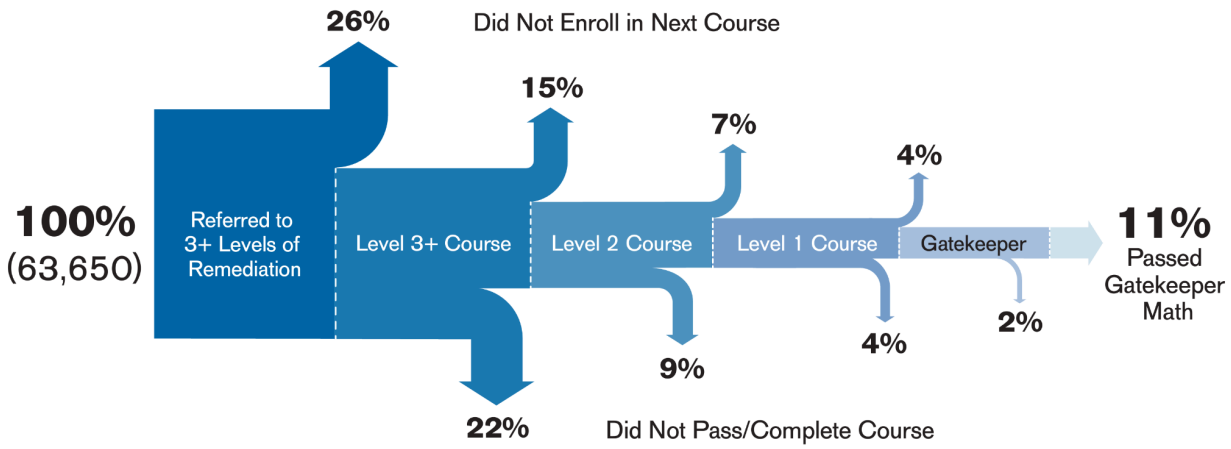
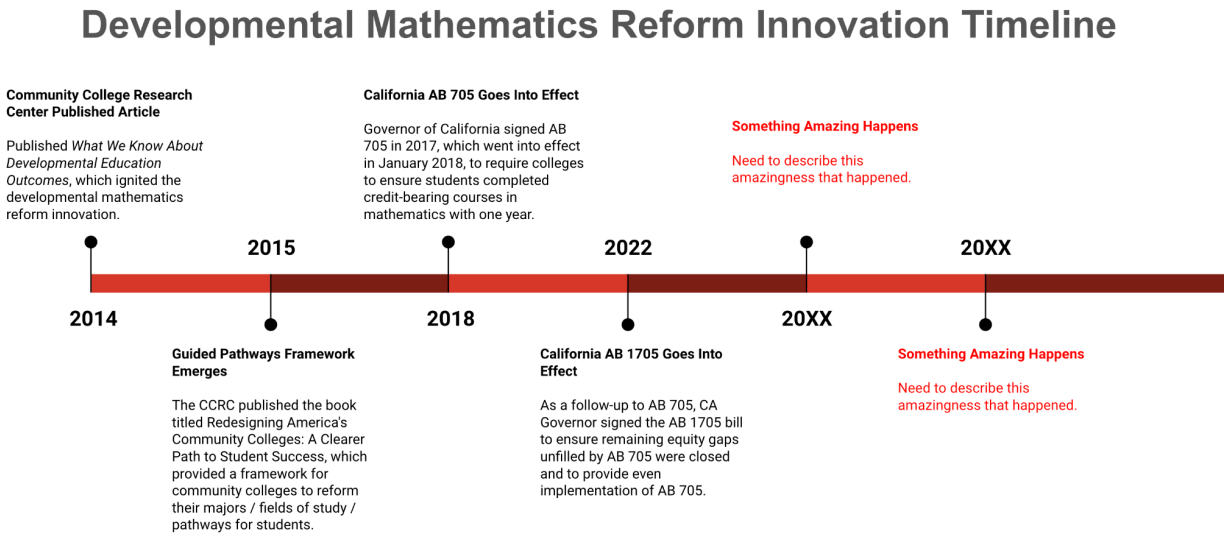


Figure 1: Student Progression Data Through Developmental Mathematics (Jaggars & Stacey, 2014).

Students in the first two years of college often attempt one course and not others, or do not take mathematics courses at all, which minimizes the chance for students to obtain a degree or certificate, or transfer to a four-year institution (Mills, 2016). With the vast majority of students falling through these pipeline crevasses, it is clear that mathematics represents an overwhelming barrier to degree completion, especially for students aiming to obtain a degree from a four-year institution, and contributes to a lack of persistence in STEM disciplines. This challenge fueled significant work, and met with impressive results, by the University of Texas Dana Center and the Carnegie/West Ed partnership to develop quantitative and statistical reasoning pathways to serve as more career-related pathways for non-STEM students (Sowers & Yamada, 2015).



What are Some Key Terms to Know?

- **Corequisites:** a course taken at the same time as a credit-bearing mathematics course (such as College Algebra, Calculus 1) focused on offering just-in-time skills (e.g., reviewing slope of lines before a calculus 1 derivatives lesson), and reinforcement of topics in the paired math course. These are often 0-2 credit hours, and are sometimes paired so the same instructor has the same students, or consolidated so all the students for a particular course (calculus 1) are combined into one co-requisite section.
- **Pathways:** Sequences of mathematics courses students can take, including prerequisites, until fulfilling the mathematics requirement for their major
- **Guided Pathways**

How Does this Play Out Across the System?

<table>
<tr><th>Institution</th><th>Department</th><th>Course</th><th>Classroom</th></tr>
<tr><td>Placement policies (multiple measures, student-led)

How developmental courses are set up for credit hours

Classroom renovations to make space for student collaborations & sharing

Scheduling/registration issues in paring co-requisite courses with math courses

Mathematics Learning Centers</td><td>Scheduling and staffing developmental & co-requisite courses, Math Learning Center

Sequencing of courses

Communicating with other departments to align math pathways with the mathematical knowledge and skills required for majors</td><td>Course coordination

Instructor community of practice

Course materials that connect to careers and “real world”</td><td>Active student engagement

Inclusive teaching practices

Assessment for learning</td></tr>
<tr><td colspan="3">• Access to and use of data to inform the outcomes of improvement efforts
• Professional learning for instructors
• Culture of expecting instructional improvement
• “Right math for the path”: setting up multiple pathways (with opportunities to change paths) into mathematical literacy
• Coordinating with the mathematical skills and knowledge needed for other majors</td><td></td></tr>
</table>

Who's Who? (a few starting points)

- Community College Research Center https://ccrc.tc.columbia.edu/
- UT Dana Center https://www.utdanacenter.org/
- Strong Start to Finish https://strongstart.org/
- Complete College America https://completecollege.org/
- CAPR: Center for the Analysis of Postsecondary Readiness https://ccrc.tc.columbia.edu/research-project/center-analysis-postsecondary-readiness.html
- Corequisite Toolkit https://strongstart.org/resource/corequisite-mathematics-toolkit/
- People
    - Uri Treismann (UT Dana Center)
    - Nikki Edgecombe (CAPR and CCRC)
    - Susan Bickerstaff (CCRC)
    - Elizabeth Zachry Rutschow (American Institutes for Research)

What Do We Know (to date)?

- Corequisites offer a sustainable funding model that other supports (embedded tutoring, supplementary instruction) do not.
- The return on investment that results from increased student retention offers positive incentive.
- Students are more motivated to persist in courses that seem relevant and engage them.

What Should You Do Now?

<table>
<tr><th>Institution</th><th>Department</th><th>Course</th><th>Classroom</th></tr>
<tr><td>Co-requisite courses can be an effective alternative to developmental sequence of courses, but a key consideration is credit hours. If co-requisite courses are credit-bearing, then failing a math course can have bigger impacts on a GPA; if co-requisite courses</td><td colspan="2">To foster an instructor community of practice, protect one hour where no sections of that course are offered, thus making time for a regular instructor meeting to have conversations about teaching and learning that course

Instructors need support to teach in engaging and inclusive ways, so initial and ongoing professional development should be offered and expected.</td><td>Instructors need to consider how to help students develop growth mindsets toward learning mathematics and mathematical skills, particularly for students who have failed this course in the past or who have taken a version of this course in the past.</td></tr>
</table>

are not credit-bearing, the institution needs to plan the funding model for staffing such courses.			
Determine appropriate course offerings (right math for the path) that also have flexibility for students to shift paths if they change majors		Curriculum should be something other than repeating the same prior courses that students failed; align course content with students' intended majors.	
Placement policies are an important part of reforming developmental mathematics. We know that black and brown students are placed into developmental mathematics more often, and that being placed into a sequence of developmental mathematics (multiple courses required before getting to actual prerequisite/required courses for the major) is unsuccessful for the vast majority of students.		Ensure assessment approaches align with the active engagement approaches to developmental and co-requisite courses; connections to [standards-based assessment]<link>	
Advisors need to be educated on math pathways and considerations for placing students in their initial mathematics courses Advisors can also help students understand co-requisite courses, encouraging students to see these as positive supports and not negative requirements.	Placement policies should support instead of sort students Focus on supporting students (especially using corequisites) in the gateway course instead of investing in prerequisite courses.		

How Can You Learn More?

- **I want to connect with others engaged in this same innovation**
    - Zulip Network for Teaching-Focused Faculty https://ebme.zulipchat.com/join/sv2yipipthgpv7zybvmbf5je/
    - MAA Connect https://connect.maa.org/

- **I need to convince an administrator (dept chair, dean) that reforming developmental mathematics is worthwhile:**
    - MAA Blog https://maa.org/developmental-mathematics-a-new-approach
        - Although dated, this blog post demonstrates the desire to improve student success through changing developmental education pathways; the arguments here are likely to resonate with administrators (dept chairs, deans)
- **I want some ideas for starting places to reform developmental mathematics:**
    - E. Silva & T. White (2013). Pathways to Improvement: Using Psychological Strategies to Help College Students Master Developmental Math. [Quantways and Statways]https://eric.ed.gov/?id=ED560149
    - Complete College America. Math Pathways. https://completecollege.org/strategy/math-pathways/
    - An Unexpected Key to Performance in Gateway Mathematics Courses. J. Edelman. DiverseEducation.com. (2023) https://www.diverseeducation.com/reports-data/article/15635073/an-unexpected-key-to-performance-in-gateway-math-courses
- **I want to know more about the history of developmental mathematics reform (and get some ideas about where to start):**
    - Redesigning America's Community Colleges: A Clearer Path to Student Success--this is a CCRC book that started the guided pathways movement in community colleges; this information is still relevant for other institutions of higher education confronting ways to reform developmental education pathways.
- **I want to think more about the implications and challenges of developmental mathematics reform as they play out across different levels/dimensions of the system:**
    - The Challenges of Scaling Gateway Mathematics Corequisites: Recommendations for Policy and Practice. Report. Sean C. Pepin. Charles A. Dana Center. (2022) https://dcmathpathways.org/sites/default/files/resources/2022-10/crdc_challenges_scaling_gateway_math_coreqs_08oct2022.pdf
- **I want to see more about the research behind developmental mathematics reform**:
    - Research on Developmental Education (overview and links). Community College Research Center. https://ccrc.tc.columbia.edu/research/developmental-education.html
    - Making It Through: Interim Findings on Developmental Students' Progress to College Math with the Dana Center Mathematics Pathways. Research Brief. E. Zachry Rutschow. (2018). https://eric.ed.gov/?id=ED586095
    - Hodara, M. (2019). Understanding the developmental mathematics student population: Findings from a nationally representative sample of first-time college entrants. https://www.nationalacademies.org/documents/embed/link/LF2255DA3DD1C41C0A42D3BEF0989ACAECE3053A6A9B/file/DF32369C97AE56412D8BF60487E0A51897D43765E3A1