ALIGNED BY DESIGN: HOW CROSS-SYSTEM MATH ALIGNMENT CAN IMPROVE STUDENTS' PATHWAYS FROM HIGH SCHOOL TO COLLEGE

By Shakiyya Bland and Pamela Burdman

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JUST // EQUATIONS

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ABOUT JUST EQUATIONS

Just Equations reconceptualizes the role of mathematics in ensuring education equity for students. An independent resource on the equity dimensions of math education in the transition from high school to college, Just Equations advances evidence-based strategies to ensure that math policies give all students the quantitative foundation they need to succeed in college and beyond. Just Equations' work is currently supported by College Futures Foundation and the Gates Foundation.

ABOUT THE AUTHORS

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PAMELA BURDMAN, founder and executive director of Just Equations, is an expert on college access, readiness, and success. A thought leader on the role of mathematics in education equity, she synthesizes knowledge at the intersection of research, policy, and practice. Burdman has written 18 reports and more than 70 articles on math education policy issues over the last 10 years. Her experience in journalism, including covering issues such as California's reversal of affirmative action as a *San Francisco Chronicle* reporter, informs her commitment to education equity. She also worked as an education program officer for the William and Flora Hewlett Foundation.

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EXECUTIVE SUMMARY

ENSURING THAT STUDENTS not only transition successfully from high school to college—but also complete college prepared to enter the workforce and earn a living wage—remains one of the greatest challenges faced by our education systems. And misalignment in math education can serve as a singular barrier to successful transitions. The manifestations include:

- Repetition of course content in high school and college
- Math requirements that lack relevance to students' college and career goals
- Assignment to sometimes-lengthy remedial college math through use of placement tests with questionable validity
- College admissions requirements that exceed high school graduation requirements, favoring completion of five years of high school math

The absence of alignment and transparency across high school and college math requirements can lead students to feel demoralized, question their own abilities, and lose time and money—effects that often fall hardest on students of color, low-income students, and students whose parents did not attend college.

Leading math associations have championed the need to modernize mathematics education to make it more engaging for students while reflecting the evolving needs of the 21st century. Numerous states have responded by redesigning their pathways, initially at the college level and more recently adding high school math courses, such as statistics, data science, computer science, and discrete math.

Because postsecondary institutions play a pivotal role in setting the bar for high school curriculum, ensuring that students develop the mathematical foundations they need requires collaboration between K–12 and higher education systems. As such, it is important to understand how specific math-related strategies can strengthen students' transitions from high school to college.

POLICIES AND PARTNERSHIPS TO STRENGTHEN ALIGNMENT

Just Equations identified **five key strategies** that states can implement to enhance the effectiveness of the math pathways from high school into college and has highlighted a state that has implemented each one:

COURSE CO-DESIGN ensures that students' preparation meets the demands of colleges, reducing the need for repetition of courses and streamlining students' paths. As part of **Georgia**'s 2020–21 standards review, higher education faculty participated alongside K–12 educators on committees that were designing new courses, contributing to discussions about the mathematical content that all students need to be prepared for college.

TRANSPARENT EXPECTATIONS from higher education institutions help ensure that students' high school math courses prepare them for college study in their desired field of study. In 2025, a group of faculty representing **California**'s three public higher education systems worked with K–12 leaders to produce a statement highlighting the high school math preparation needed for college success in general and in specific majors.

READINESS COURSES allow students to use their senior year of high school to ensure they are ready to start college-level math when they start college without a need for remedial courses. Over a 15-year period, beginning with the state's decision to require four years of high school math, **Tennessee**

postsecondary and K–12 leaders worked together to develop and refine readiness courses aligned with college demands.

DUAL-ENROLLMENT courses allow students to take college courses while still in high school, earning credit toward a degree. Driven by strong partnerships, **Utah**'s dual-enrollment program dramatically expanded senior-year math course-taking, reduced college remediation rates, and expanded the range of math pathways available to high school students.

ALIGNED ADMISSIONS policies ensure that public postsecondary institutions recognize high school course redesigns. When **Oregon** education leaders updated the state's high school math requirements, they worked with higher education leaders to ensure that college admissions statements made clear to students and families that new course options were recognized by the state's public universities.

RECOMMENDATIONS

Collaborations across systems to streamline students' journeys support several goals for advancing equitable high school math pathways:

EXPANDING OPTIONS **so that students can take high school and college math courses aligned with their interests**

ENHANCING PREPARATION **by increasing equitable access to advanced math courses for students who demonstrate readiness**

ELIMINATING BARRIERS **by ensuring that students' high school coursework meets college expectations**

Most of the strategies highlighted in this report can apply across a variety of state contexts. But for K–16 mathematics alignment to strengthen outcomes requires that states commit time, money, and expertise to address complex challenges. Here are steps that K–12 and higher education systems can take to support collaboration and ensure that math courses support seamless transitions:

+ **ESTABLISH AND SUSTAIN ACTIVE STRUCTURES FOR COLLABORATING.** **Such structures need to be ongoing and have clear accountability, including the participation of leaders with authority over system priorities and resources.**

+ **INVEST IN RESEARCH AND DEVELOP ROBUST K–16 LONGITUDINAL DATA SYSTEMS.** **High-quality research based on robust data systems is necessary to ensure that policies are developed and refined based on up-to-date evidence.**

+ **SUPPORT AND SUSTAIN IMPLEMENTATION THROUGH PROFESSIONAL DEVELOPMENT.** **Effective professional development, including through cross-system partnerships, helps educators translate policies into expanded access to rigorous coursework and meaningful classroom practices.**

+ **PROVIDE TRANSPARENT INFORMATION AND EFFECTIVE ADVISING.** **Students, families, counselors, and teachers require accurate, up-to-date, and accessible information about enrolling in mathematics courses to ensure that students from all backgrounds can access and succeed in mathematics courses that open doors to their chosen fields.**

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"Some of the most robust challenges in raising student achievement can be found at the juncture—or more accurately the disjuncture—between our K–12 systems and our colleges and universities." **CALLAN ET AL., 2006**

THAT INSIGHT REMAINS TRUE TODAY: Ensuring that students not only transition successfully from high school to college—but also complete college prepared to enter the workforce and earn a living wage—is one of the greatest challenges faced by our education systems.

Math education lies at the heart of this challenge: Research over the past decade (Bressoud, 2021; Burdman, 2015; Daro & Asturias, 2019; Ngo & Melguizo, 2020) has underscored how misalignment in math education can serve as a singular barrier to academic progress.

The manifestations are multiple, including:

- Repetition of course content in high school and college
- Math requirements that lack relevance to students' college and career goals
- Assignment to sometimes-lengthy remedial college math sequences—which can delay or deter students' progress to degrees—through use of placement tests with questionable validity
- College admissions requirements that exceed high school graduation requirements, favoring completion of five years of high school math

For students, the absence of alignment and transparency across high school and college math requirements can lead them to feel demoralized, question their own abilities, and lose time and money. Those effects often fall hardest on students of color, low-income students, and students whose parents did not attend college (Ngo & Melguizo, 2020). "The vast majority of students matriculate into some form of postsecondary education," note Kirst and Venezia (2018, p. 188). "Underserved students face many more challenges navigating into and through higher education than do traditional college-bound students. Efforts to connect the systems must overcome deep divisions." Ensuring curricular alignment to improve students' math preparation is a central component of this work.

Leading K–12 and higher education math associations have championed the need to modernize mathematics education to make it more meaningful and engaging for students while also reflecting the evolving needs of the 21st century (National Council of Teachers of Mathematics [NCTM], 2018, 2024; Saxe & Braddy, 2015).

Numerous states have responded by redesigning their pathways, often beginning at the postsecondary level, to align math coursetaking with students' interests and program of study, rather than requiring all students to take courses such as college algebra (Burdman, 2015; Burdman et al., 2018; Charles A. Dana Center, 2019). More recently, some K–12 systems have also been redesigning high school math sequences to include such options as statistics, data science, computer science, and discrete math in an effort to respond to the higher education changes and ensure that math courses are relevant to students' interests and responsive to workforce needs (Barnett et al., 2022; Charles A. Dana Center, 2020; Darling-Hammond, 2025; Daro & Asturias, 2019; Moussa et al., 2020).

Ultimately, ensuring that students develop the mathematical foundations they need to navigate their paths through high school and college successfully is a collaborative effort across K–12 and higher education systems. Higher education institutions play a pivotal role in setting the bar for high school curriculum through the signals they send about the competencies students must master for successful college entry. A major objective is for states to create a connected K–16 learning ecosystem that provides every student with meaningful preparation to attend college and succeed in a rapidly changing, data-driven world (Bland et al., 2024).

At least 31 states have developed some form of cross-sector partnerships focused on math pathways from high school through college, according to *Charting the Course*, a recent report from the University of Texas' Charles A. Dana Center and Education Strategy Group (2025). As such partnerships expand, it is important to understand which math-related practices and policies have promise for improving students' transitions from high school to college and how states and systems have implemented them. Shedding light on such strategies is the focus of this report.

ABOUT THIS REPORT

Research documenting alignment between K–12 and higher education is limited, leaving state leaders and policymakers to make high-stakes decisions without a clear roadmap for coordinating across sectors. Challenges such as fragmented governance, incomplete student transition data, and the difficulty of evaluating cross-system policies complicate efforts.

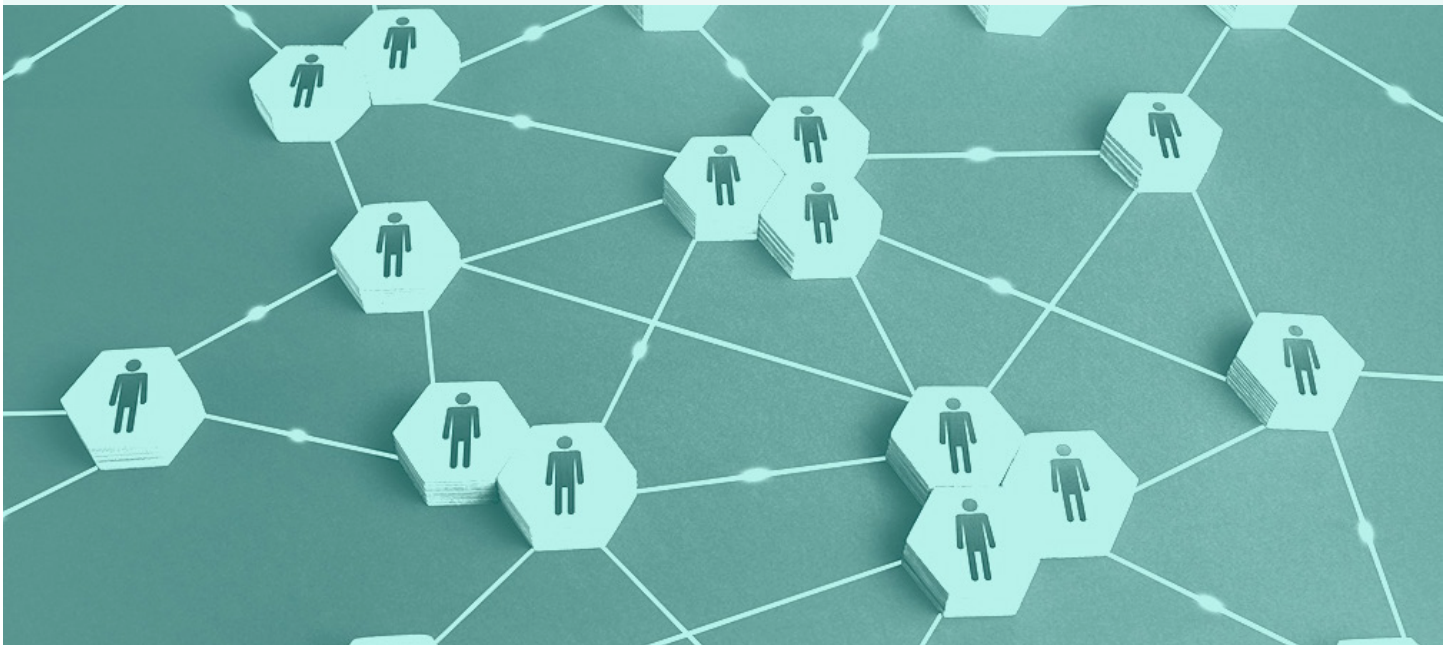
Just Equations' recent report Beyond Algebra: High School Math for a New Generation (Bland et al., 2024) examined how states are modernizing high school math courses and sequences to better align with students' college and career interests, as well as with the growing demand for data literacy. Building on that publication, and based on interviews with education officials involved in redesigns, this report explores concrete ways that K–12 and higher education systems can collaborate to create more coherent math pathways to smooth the transition from high school to postsecondary education.

Specifically, this report:

- Highlights promising math-alignment efforts by state education agencies and state higher education systems to support college readiness and streamline students' educational journeys
- Examines key challenges and opportunities related to aligning math policies across educational systems
- Presents actionable steps education policymakers can take to build stronger, more coherent pathways through high school and college mathematics

METHODOLOGY. This analysis pointed to several ways state systems have collaborated to address issues of misalignment in mathematics requirements and examined how various policy solutions affected student progression and educational equity. Initially, the research team synthesized findings from prior Just Equations analyses, the literature on high school and college math policies, and interviews with experts who monitor state math education policies to consider promising approaches to math curricular alignment. The team examined seven strategies, ultimately identifying five state examples of effective cross-system collaboration to highlight.

Between July and September 2025, the research team conducted 27 semistructured Zoom interviews with education professionals involved in mathematics policy development and implementation. Interviewees included 10 state public education officials, nine higher education administrators, three mathematics faculty, and several other experts (see appendix for a full list of interviewees). Interviews focused on policy creation, implementation challenges, and measurable outcomes. In addition, the team reviewed existing research on the various policy strategies, as well as publicly available materials from state agencies, including policy documents, system guidance, legislative texts, and institutional websites.



POLICIES AND PARTNERSHIPS TO STRENGTHEN ALIGNMENT

Just Equations identified five key strategies that states can implement to enhance the effectiveness of the math pathways from high school into college and chose a specific state to illustrate each one:

COURSE CO-DESIGN

Partnerships between K–12 and higher education faculty to design high school math sequences (Georgia)

TRANSPARENT EXPECTATIONS

Clear guidance from higher education institutions on appropriate high school math preparation for various fields of study (California)

READINESS COURSES

Senior-year transition or readiness courses to prepare students for college-level math (Tennessee)

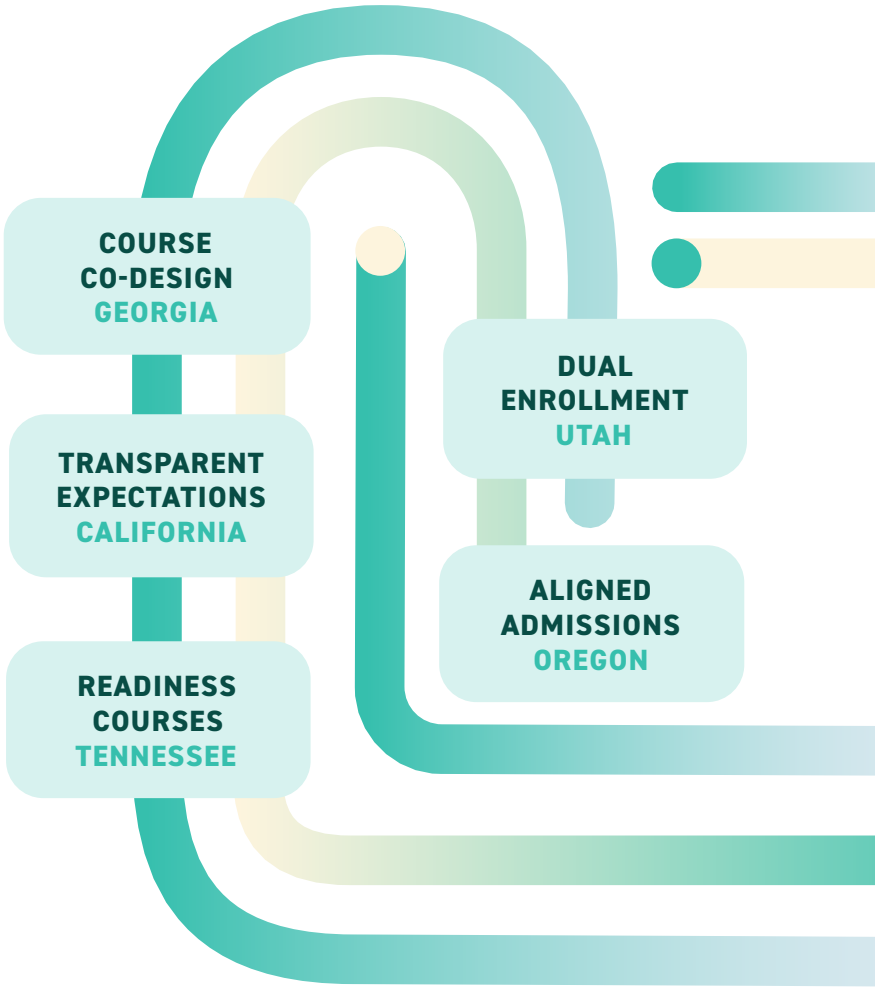
DUAL ENROLLMENT

College courses for high school seniors to expand math course options and increase senior-year math coursetaking (Utah)

ALIGNED ADMISSIONS

Updates to admissions policies to align with expanded high school math options (Oregon)

As the state profiles throughout this report highlight, each of these strategies can respond to equity concerns—though states' definitions of "equity" have shifted, and some no longer use the term. An Oregon leader shared a vision in which student enrollment in each of the state's high school math courses roughly mirrors the state's demographics. Tennessee officials used the term "open access" to describe the goal of ensuring that students from all backgrounds can pursue math opportunities that open doors to higher education and careers. A California leader noted that transparency around university expectations is essential for equity.



CO-DESIGNING COURSES IN GEORGIA

Georgia redesigned its mathematics course pathways through a collaborative partnership between K–12 and higher education math educators, ensuring that new high school courses align with college entry requirements and workforce readiness goals.

Georgia's mathematics pathways redesign emerged from two critical concerns: ensuring that high school mathematics courses would prepare students for future postsecondary opportunities and providing open access to math courses for all students in the state. When the process began, leaders with the Georgia Department of Education (GaDOE) had noticed that some high school mathematics courses were not being recognized by the state's public universities for admission, leading to questions about whether all courses were adequately preparing students for the future.

The state's 2020–21 K–12 standards review process, led by the GaDOE, included involvement from the state's Mathematics Advisory Council. The council—which provides ongoing input on mathematics programming and policy—has standing positions for representatives from public two-year colleges, four-year colleges, and technical colleges within Georgia, as well as K–12 teachers and school leaders. Involving the council ensured that higher education mathematics faculty participated directly in developing new high school courses. The department also sought input from industry professionals and community members.

During the process, each course had a curriculum development committee that included at least one mathematics professor from the University System of Georgia and one from the Technical College System of Georgia, along with high school teachers, with some courses requiring with more complex courses requiring additional faculty. Higher education faculty participated in reconceptualizing course content, contributing to discussion about what mathematical content all students truly needed versus what belonged in specialized courses.

As part of the Charles A. Dana Center's Launch Years Initiative, Georgia math leaders involved in the standards review considered expanding the range of courses available to students in their third year of high school math. But the idea that some students might be steered into "Algebra II equivalents" regarded as less rigorous raised concerns, given that Algebra II had until then been required for all students. This prompted a shift toward a common pathway to provide all students, regardless of background or location, the same preparation through the first three years of high school (Barnett et al., 2022). These conversations led to significant restructuring, including the decision to modernize Algebra II for all students rather than create separate tracks.

The restructured course, Advanced Algebra: Concepts and Connections, reflects a vision of ensuring that all students are prepared for the future. Rather than choosing among different pathways, all students now take the same modernized course that emphasizes functional and algebraic reasoning using technology tools; covers inverse, logarithmic, exponential, and quadratic functions with limited complex numbers introduction; and includes linear programming components.

For the senior year of high school, Georgia added courses such as Advanced Placement Statistics, Advanced Mathematical Decision Making, Linear Algebra With Computer Science Applications, and Mathematics of Industry and Government, making sure that each high school "fourth math" course genuinely equips students for college-level studies. By having university faculty evaluate and approve each option, the state built confidence that these courses would be recognized as meeting colleges' readiness expectations/requirements.

"One of the biggest mindset shifts was realizing that not all students need the traditional algebra–calculus sequence to succeed in college or careers. Opening up statistics and quantitative reasoning pathways allowed for broader access without lowering expectations," shared Melanie Largin, assistant vice chancellor of general education and student pathways within the University System of Georgia, a member of the Mathematics Advisory Council who was closely involved in the standards review process.

By involving higher education faculty in the front-end development process, Georgia increased the likelihood of approval by the Academic Committee on Mathematical Subjects, a group of mathematics leaders from all 26 of the state's public higher education institutions that reviews and approves courses for use in university admissions. All courses were unanimously approved by the committee, as well as the State Board of Education, and implemented in 2023. But that was not the only achievement.

"The success was not just the alignment of policies but the relationships built—university professors began to understand how high school math is designed, and high school teachers could hear directly the expectations of college classrooms," said Largin.

Though it will take several years to fully understand the effectiveness of these changes, early signs are positive. Georgia students showed consistent progress in algebra proficiency on the Georgia Milestones assessments in the two years since the rollout of the state's updated first-year algebra course, Algebra: Concepts and Connections, with the percentage of students scoring proficient or above in the course increasing from 36 to 45 percent (Georgia Department of Education, 2025, p. 3). In 2025, 84 percent of students who completed the AP Precalculus exam earned a qualifying score of 3 or higher, according to state officials. Officials largely attribute this result to the strength of the modernized Algebra II course.

The process also revealed other tensions and ongoing needs. Implementing changes to high school math courses and sequences is not just a matter of curricular redesign; it requires significant professional development for counselors and instructors, particularly to prevent informal tracking and support students who face academic or social barriers. The most significant challenge involved shifting mindsets among K–12 and higher education math faculty who hold intrinsic beliefs about students' capabilities. This cultural shift requires persistent effort from teachers, consistent reinforcement from leadership, and ongoing attention to empirical evidence, as traditional attitudes on the part of instructors can unconsciously influence student opportunities and expectations.

Leaders recognize that policy changes at the standards and course level have not yet fully translated into shifts in classroom instructional practice. Deeper engagement between high school and postsecondary mathematics instructors remains a future goal.

HEIGHTENING TRANSPARENCY IN CALIFORNIA

California K–12 and higher education leaders produced a joint statement to highlight the high school math preparation needed for college success in general and in specific majors. The goal is to provide clear and coherent signals about how a range of fourth-year high school math courses tailored to specific interests can prepare students for college, offering transparency for high schools in choosing which courses to offer—and for students, families, and the counselors who advise them about their enrollment decisions.

Traditionally, education systems in California have provided conflicting messages about high school math preparation: Though state law requires students to take only two years of math in high school, many school districts require three or more years. Both of the state's public university systems require three years of math and recommend four (Burdman, 2016; Gao, 2017).

Perhaps because of the mixed signals, fewer than half of California seniors take advanced math. A quarter take no math at all. And access is quite inequitable, with Asian, White, and high-income students taking courses beyond Algebra II at much higher rates than Black, Latinx, and low-income students (Asim et al., 2019).

One recommendation for broadening access has been to increase the availability and variety of high-quality senior-year math courses that prepare students for college (Burdman, 2016; Reed et al., 2023; Wainstein et al., 2023). In 2016, the University of California (UC) clarified that calculus was not a requirement for college admission (Board of Admissions and Relations With Schools, 2016). Later that year, the state supported grants to develop and evaluate new high school courses—including one in data science, one in discrete math, and one in mathematical reasoning. Research suggested that the courses contributed to stronger outcomes—with some

courses linked to increases in students' likelihood of attending college, for example (Reed et al., 2023).

Nevertheless, state entities were not aligned on the status of these new offerings. Some of the courses had been approved for years to fulfill the third-year math requirement for admission to state universities in lieu of Algebra II. However, that approval was little known until it surfaced in 2022 during discussions of the state's new K–12 math framework. Vocal STEM faculty at the UC expressed alarm. Though only .02 percent of UC applicants were taking a non-algebra course instead of Algebra II, faculty worried that students could be shortchanged on Algebra II content and unwittingly rule out a STEM future (Burdman, 2023; Watanabe, 2024).

In response to the controversy, a UC faculty committee reversed the policy, clarifying that third-year courses must cover core Algebra II standards (Alcantara, 2024; Burdman, 2024, 2025; Fensterwald, 2024a). Though the innovative courses still apply toward admission for students who completed Algebra II (or Integrated Math III), the outcry stirred uncertainty among high schools (Fensterwald, 2024b), created a chilling effect around some of the courses, and stimulated scrutiny from state legislators about the UC decision (Burdman, 2024).

In an October 2024 hearing, President of the California State Board of Education Linda Darling-Hammond highlighted the dilemma. "No other state in the nation ... has a higher education body which prescribes and approves the content of specific courses ... [that] must be met by all in-state applicants in order to be eligible for admission," she told legislators. "We have inherited

a fragmented and antiquated governance structure for education in California," she added. "There is no established mechanism to coordinate between and among higher education segments and K–12 … to prepare students to succeed in this rapidly changing world" (Darling-Hammond, 2024).

At the time, an umbrella group of California public higher education faculty recognized the need to update their statement on mathematics preparation, partly in light of the math framework's 2023 update. That statement, first issued in 1997, had last been revised in 2013, upon introduction of the Common Core math standards. The group, the Intersegmental Committee of the Academic Senates (ICAS), consists of representatives from all three of the state's higher education systems: UC, California State University (CSU), and the California Community Colleges (CCC). ICAS appointed a subcommittee of math faculty from each of the three systems. "A lot had happened in 30 years," said Michael O'Sullivan of San Diego State University, one of the subcommittee co-chairs. He noted that having all students arrive in college well prepared supported the group's goal of "stronger and more equitable student outcomes."

To ensure that the mathematical content it recommended reflected the needs of a range of disciplines, the subcommittee distributed a questionnaire to faculty from all three systems inquiring about which math competencies are important in their fields. It also **analyzed the mathematical demands of AP exams** in fields such as world history, psychology, economics, and biology. The California Department of Education's director of curriculum frameworks joined subcommittee meetings and signed the final statement. While prior decisions from UC's faculty had focused narrowly on admissions requirements, the new statement (Intersegmental Committee of the Academic Senates, 2025) provides a more holistic vision for high school math in three ways:

FIRST, in addition to specific math topics, it underscores the **importance of competencies** such as conceptual understanding, reasoning, mathematical modeling, and mathematical dispositions. It recognizes sensemaking, communication, and collaboration as critical to mathematical endeavors.

SECOND, the statement highlights critical high school algebra and geometry concepts, emphasizing depth of understanding while **deprioritizing some traditional topics**. This creates an opportunity for reimagining these courses. De-emphasized areas included complex numbers, higher-degree polynomial equations, and complicated manipulation of power functions, said O'Sullivan. "We wanted to try and get at what was really essential for students to know."

THIRD, the subcommittee highlights the most helpful math preparation for each of **six discipline areas**. Precalculus or calculus is a stepping stone to most STEM majors. For arts and humanities, statistics and data science are good preparation. For students pursuing other majors—such as social sciences, business, economics, and life sciences—both calculus (or precalculus) and statistics have value, ICAS notes, as do "mathematically rich" courses in data science.

Sending an important signal, the UC's admissions committee endorsed the statement. Though the statement changes no current policies, its unified message creates a framework for modernizing foundational math courses and expanding senior-year offerings. It could also open doors for improved math collaboration in the state, noted Darling-Hammond, which is especially relevant now that California has adopted a new interagency council to help integrate education and employment systems.

Collaboration is required to enhance transparency, and transparency is key to equity, as Chase Fischerhall, who oversees evaluation of high school courses for admissions eligibility for the UC system, observed. "The goal in this particular moment was to get to a point where at least the expectations across the CCC, CSU, and UC systems could be stated more clearly and more transparently," he said. "The hope is that equity and equitable access will be enhanced if things are more transparent."

PIONEERING READINESS COURSES IN TENNESSEE

For more than 15 years, postsecondary and K–12 leaders in Tennessee have worked together to increase college readiness, access, and success by supporting high school students to take four years of math while expanding enrollments in nonmainstream courses such as high school and college statistics. A focus of these efforts has been the Seamless Alignment and Integrated Learning Support (SAILS) program.

The seeds were planted in 2008, when Tennessee became the second state to increase its high school graduation requirements to include four years of math, including Algebra II. An opportunity for students, it marked a considerable stretch for math educators.

"The work to lift all students to completing a four-year math requirement was enormous," recalled Scott Eddins, who at the time was leading math initiatives for the Tennessee Department of Education (TDOE). "There were plenty of high school teachers who would just say, 'Honey, you shouldn't be in this class.'"

High schools began offering a bridge course to boost students' math preparation in their senior year, but large numbers of students were still scoring below 19 on the ACT—and landing in college remedial math. To address the challenge, Chattanooga State Community College piloted a program within the bridge course for 24 students at nearby Red Bank High School in the spring of 2012. Under the program, known as SAILS, bridge course students who passed the self-paced, modular, online curriculum could enroll directly in college-level math when they enrolled in a community college. Two-thirds of students succeeded in the pilot.

What began as one college's approach to math readiness soon became a statewide strategy to help students start college ready for credit-bearing math (Pearson, n.d.). The initiative caught the attention of then Tennessee Governor Bill Haslam, who launched a campaign in 2013 called Drive to 55. Its goal was to raise attainment of degrees and certificates among

Tennesseans from 32 percent to 55 percent by the year 2025 (Tennessee Office of the Governor, 2014). A clear obstacle was the fact that nearly 70 percent of the state's community college students were being placed into remedial math courses each year (Higher Education for Higher Standards, 2016).

A 2013 grant from the governor's office extended SAILS to 118 high schools and all 13 community colleges. The grant reached more than 8,000 students, who accessed the SAILS modules by enrolling in the bridge course. In the first year, Tennessee students saved at least $6 million in tuition and more than 11,000 semesters of math remediation. By 2015–16, more than 14,000 students a year at 243 high schools were taking the course, and success rates had increased to 92 percent (Higher Education for Higher Standards, 2016; Kane et al., 2018a).

In 2018, SAILS moved to the Tennessee Board of Regents (TBR), which oversaw a group of field coordinators at every community college and provided the training. By that point, the strategy of leveraging the senior year of high school to ensure math readiness had taken hold. It was an illustration of what Juliette Biondi, current SAILS program director, described as Tennessee's "relentless commitment to open access and ensuring that we are meeting the needs of multiple demographics of students."

But the details of the program would morph considerably, because of major shifts in math policies around the state. First of all, in 2015, all Tennessee community colleges began implementing corequisite strategies, replacing traditional remedial education with concurrent support courses for students who weren't deemed ready for college-level math. SAILS therefore no longer played the role of placing students out of remedial prerequisites (Kane et al., 2018b). Also around that time, the TBR made statistics the default math course for community college students who were not pursuing a STEM degree.

As a result, the K–12 system decided to review its algebra-focused high school bridge course. It served a high proportion of students from underserved backgrounds, but it no longer served a clear purpose, with statistics becoming the general entry-level math course and most students heading for calculus already taking precalculus as seniors, according to Virginia Mayfield, senior director of math, science, and instructional materials at the TDOE. Ultimately, the bridge course was slated for elimination.

Despite SAILS' success, it was not an independent high school course. It was a curriculum schools could offer within their bridge course. Elimination of the bridge course and the adoption of statistics as a default general education course spurred TDOE and TBR to codevelop a SAILS course focused on statistics.

There had long been a high school statistics course. But, when College Algebra was the general education requirement for college students, few students took statistics. The new policies brought more attention to statistics. "For many, many students, it makes more sense than college algebra," noted Eddins, now the TDOE's mathematics coordinator. "There's a more obvious connection to the real world and to problem-solving that they're actually going to use and need."

SAILS Statistics came online in 2022. Meanwhile, the TDOE decided to replace its old bridge math course with Mathematical Reasoning for Decision Making and sought help from SAILS to develop the course. After a 2023–24 pilot, that new course is now offered for students heading to the workforce, the military, or to a Tennessee college of applied technology, and is being considered by community colleges to place students directly into college-level math without a corequisite.

In Eddins' view, SAILS has helped shift the emphasis in Tennessee high schools to student success. "We're seeing a big change in that culture … in part due to the SAILS program and our fourth-year math requirement and convincing our high school math teachers that you got them and you gotta graduate them," he said.

Early versions of the program received positive evaluations. Researchers at Harvard documented a 13 percentage point increase in students passing college math by the end of their first year, as well as increased enjoyment of math, particularly for Black students (Kane et al., 2018a). But understanding the effects amid the shift in math curriculum and placement policies has been a challenge, given the limited access to longitudinal data. To address that, Biondi plans to track students' performance after they enroll in the state's community colleges to gain insights on how to strengthen the program.

"One of the goals that I have over the next year or so is to better track the entire arc of the student journey," she said. "I want to understand how they do in their college math classes. Do they go from SAILS to college stats and do just fine? Do they struggle? Does it influence graduation rates? We want to ensure SAILS meets the needs of students beyond fulfilling their fourth year of high school math."

ADVANCING DUAL ENROLLMENT IN UTAH

Through its dual-enrollment program, Utah has dramatically expanded senior-year math coursetaking, provided college-level credit to high school students, and reduced remediation rates. The program offers multiple flexible pathways aligned with students' career aspirations, supported by strong statewide partnerships and evolving to ensure equity and broad participation.

Utah's Concurrent Enrollment (CE) program emerged from multiple converging needs in mathematics education. State leaders identified three related goals driving the initiative: increasing the number of students completing four years of meaningful mathematics, reducing reliance on remedial courses in college, and boosting college enrollment and completion rates (Auck & Suddreth, 2019). In addition, Utah recognized that students needed access to advanced mathematics courses beyond the traditional pathway to calculus. State education leaders wanted to offer quantitative literacy and statistics courses as viable options, acknowledging that different career paths require different mathematical foundations.

Offering dual-enrollment courses would provide legitimacy to new advanced math offerings—that is, courses beyond Math III—because the courses were already accepted by the state's higher education system. In allowing high school students to earn college math credits, the initiative was also intended as an equity strategy to make college-level courses more accessible and affordable.

In 2016, the Utah Legislature mandated that every student who completes the foundational state math sequence with a C or better be offered the opportunity to enroll in a college credit–bearing math course in any higher education institution in the state (Utah State Legislature, 2016). This legislative requirement provided the policy foundation for modernizing the state's high school math pathways.

Once the law was passed, the state's Launch Years working group deliberately moved away from a single-track model. All high school students first complete foundational integrated courses—Math I, Math II, and Math III—that serve as mandatory stepping stones to college-level options.

Lindsey Henderson, former secondary mathematics specialist for the Utah State Board of Education (USBE), emphasized the legislation's strong "shall" language, which compelled higher education institutions to collaborate and ensure the courses were available in all high schools rather than leaving participation optional. Institutions were required to specify which pathways applied to specific majors, enabling students to make informed decisions instead of assuming calculus was the only viable choice. There was also an emphasis on appealing to parents and families. "How can we support kids getting access to college-credit math in high school, because that's really appealing to parents and families? They want that option," Henderson recalled.

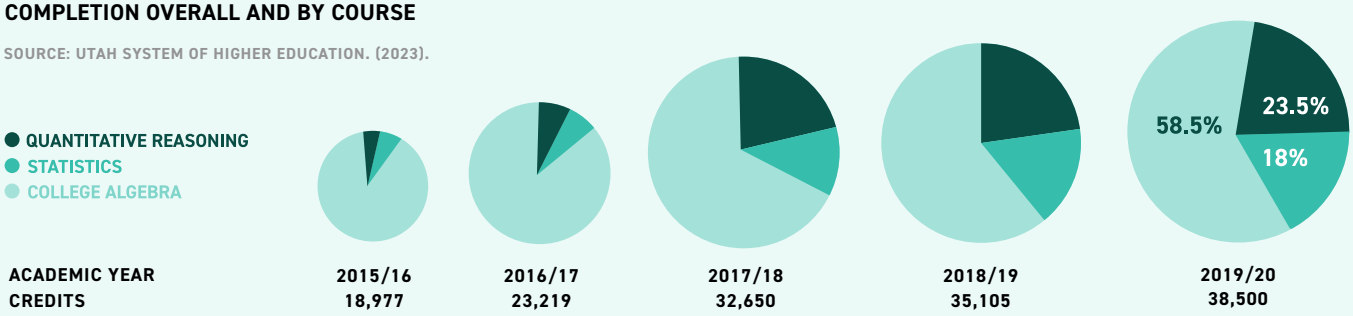
To provide those options with clarity and transparency, the state designed a graphic illustrating how each math pathway links to relevant majors (USBE, 2021b), helping students and families connect course selection with future plans.

Mike Spencer, secondary mathematics specialist for USBE, added that the new structure was designed to increase flexibility and equity in coursetaking. Each pathway is expected to be rigorous, integrating essential data literacy and quantitative reasoning, and ensuring broad applicability across professions. A crucial component was securing higher education consensus on which courses counted toward which majors, thereby reinforcing the viability of all students' future academic plans.

The program offers three college-level course options aligned with students' various strengths and career aspirations: Quantitative Reasoning, focusing on practical numeracy skills such as personal finance and

GROWTH IN UTAH'S CONCURRENT ENROLLMENT MATH COMPLETION OVERALL AND BY COURSE

SOURCE: UTAH SYSTEM OF HIGHER EDUCATION. (2023).



ACADEMIC YEAR	2015/16	2016/17	2017/18	2018/19	2019/20
CREDITS	18,977	23,219	32,650	35,105	38,500

statistical reasoning; Introductory Statistics, tailored for life sciences, business, and social sciences; and College Algebra, as preparation for calculus and STEM majors.

Once in college, students have flexibility around their trajectory. STEM options stay open, for instance, even if students start with Quantitative Reasoning. The offerings are also evolving, with emerging pilots in data science and business math designed to meet the growing demand for practical, career-focused skills.

Implementation rests on strong partnerships between the USBE and the Utah System of Higher Education (USHE), as well as among local school districts, community colleges, and universities. University professors guide development of high school syllabuses, screen high school teachers to teach the courses, and verify grading consistency using common assessments. Regular classroom visits from university math faculty and statewide faculty meetings create forums for educators from both sectors to exchange insights around curriculum and student outcomes. Strong partnerships between the USBE, the USHE, local school districts, and higher education institutions support implementation through ongoing professional development and data-sharing agreements.

Success in this initiative is measured by an increase in the proportion of students continuously enrolled in math courses throughout high school. Official reports show that, over an eight-year period, the percentage of high school students completing four years of math more than tripled—rising from 28 percent in 2012 to 87 percent in 2020 (USBE, 2021a). Henderson noted that the ultimate metric was whether more students were taking a fourth year of mathematics than before. The vision, she explained, was to see the "circle graph get bigger" in statistics and quantitative reasoning enrollment without shrinking the calculus pathway, thereby enlarging the menu of opportunities.

At the same time, challenges persist, particularly in negotiating course eligibility and prerequisite structures with colleges. For instance, one key debate was whether students who had completed Math I, Math II, and an introductory data science course were sufficiently prepared for CE statistics. Such issues require agreements between high schools and universities, reflecting the complex collaboration needed to turn legislative mandates into practices.

Steve Hood, assistant commissioner of academic affairs at the USHE, notes that faculty observe that dual enrollment alumni are generally better prepared for subsequent math coursework than their peers. This success is monitored by a statewide committee of math experts that reviews enrollment, pass, and drop rates to continually refine the program.

Closing equity gaps is an ongoing priority for the USHE and the USBE. Policymakers recognize that, without intentional strategies to make sure all students have access, CE courses could be less available to students with less privilege or less social capital. Other challenges include teacher shortages and geographic disparities limiting access to dual enrollment in some areas. Additionally, the USBE is evolving mathematics standards and defining additional high school math pathways that include emerging college-level course options, such as data science and business math. The USHE is leading efforts to pilot these CE courses. While many colleges have expanded quantitatively rich pathways, achieving buy-in from more higher education math faculty and more equitable access to advanced math courses remains an ongoing effort.

Other priorities include expanding CE math course offerings and enhancing teacher professional development. New applied math options are in progress, while clearer rubrics and professional development aim to improve instructional feedback.

ALIGNING ADMISSIONS IN OREGON

Math faculty, admissions officers, and administrators from Oregon public universities responded to revisions in the state's high school math sequence by updating their description of the math preparation required for admission. Years of coordination between K–12 and higher education math educators laid the groundwork for the agreement.

In 2021, the Oregon Department of Education (ODE) adopted new mathematics standards intended to be "more modern and equitable" (Oregon Math Project, n.d.). Instead of the conventional three-course sequence—Algebra I, Geometry, and Algebra II (or Math I, II, and III)—the state chose a two-year core curriculum followed by specialized math course options. Within this 2+1 Model, all students study core content in algebra, geometry and data/statistics, then choose their required third-year and optional fourth-year courses based on individual aspirations (Oregon Department of Education, 2022). For those intending to take calculus and engage in STEM pursuits, there are Algebra II and Precalculus courses, and a pilot course that integrates Algebra II and Precalculus. Other third-year courses—designed as rigorous and relevant options for students interested in careers that don't require calculus—offered by districts include mathematics modeling, data science, and quantitative reasoning.

When asked about equity concerns, Mark Freed, ODE's math education specialist, described the four cornerstones of math reforms: **pathways** ensure individual choice, **belonging** addresses the universal need for students to see themselves as math people, **focus** points to modernized course sequencing, and **engagement** speaks to the need for all courses to include meaningful, authentic applications. The hope is that enrollment patterns in each high school path will closely resemble the demographics of Oregon students. Four years since implementation began, ODE has begun to collect data to assess the enrollment patterns.

Though the 2+1 Model was a departure from the traditional approach in Oregon and most other states, it was the outcome of years of conversations with math educators. Those dialogues began with the question, "How much math do you expect a student with a high school diploma to know?" Freed said. That led to defining the two years of a common path and the addition of options to meet the third-year math requirement.

Since existing law requiring three years of high school math did not specify Algebra II or other course names, ODE staff had the flexibility to make those changes. However, they foresaw a potential obstacle: Some of the state's public universities listed Algebra II as an admissions requirement. Students who availed themselves of new course options could risk becoming ineligible for those campuses—an untenable outcome.

When ODE staff inquired, they learned that no university constituency—either admissions staff or math faculty—claimed ownership or knew the history of the admissions language. Furthermore, campuses had processes for making exceptions when students didn't meet published requirements, a fact many applicants might not realize from reading websites.

Working with colleagues at Oregon's Higher Education Coordinating Commission (HECC), ODE leaders brought the issue to the university provosts. Agreeing in principle to adopt new language, the provosts authorized a work group to craft a shared statement.

The group included math faculty, admissions officers, and administrators from the state's seven public

four-year universities,[1] as well as representatives from some two-year colleges. Staff from the Charles A. Dana Center assisted by facilitating a series of four two-hour meetings in 2022, as ODE was preparing to implement the new standards.

"It was really important in our group discussion that the phrasing wasn't to ask universities to change their admissions requirements. It was to ask them to be more transparent and upfront with students about what those requirements were," noted Erin Weeks-Earp, academic policy specialist with the HECC. "Everything we work on is for access and success and equitable access to educational opportunities."

One consensus the group reached early on was to focus on the content students need for college success—not course names (Anderson et al., 2023). "We focused a lot on the difference between having a content area … and a proper noun of a course," said Freed. "The difference between lowercase algebra and uppercase Algebra. One of the agreements we had was to name course content expectations for the three-credit graduation requirement, rather than specific course titles."

The discussions were informed by national trends, including updates that had already taken place at universities such as Harvard and Stanford, each of which made clear that calculus was not expected for all applicants.

According to Dave Kung, then policy director for the Dana Center, Oregon was the first state to take the issue on across all of public higher education: "We could legitimately tell Oregon that there wasn't another state where all of the higher ed folks were getting on the same page and putting up guardrails about what calculus is actually for and what it is not. It felt like we were on the forefront of something big."

There was general agreement about the need to broaden course options for students and to limit the common math required for all students to two years. A final statement about math content blended language drafted by each of the campuses.

Freed attributes that alignment to the fact that, over five years of meeting with math educators, ODE had included two- and four-year math faculty in many conversations about the standards, going so far as to create tables where half the participants were from K–12 and the other half were from higher education.

Each public university incorporated a version of the statement on their websites. For example, where previously the University of Oregon had required Algebra II for all applicants, the expectation for students applying after fall 2023 (University of Oregon, n.d.) was three or more years of high school math, which "could be satisfied by any math course with a primary focus on concepts in algebra, calculus, data science, discrete mathematics, geometry, mathematical analysis, probability, or statistics."

More challenging was the question of the fourth year of math. Oregon students can earn a diploma with three years of math, but many of the university representatives wanted incoming students to have four. The final statement ended up describing the minimum requirement as "at least three years" of high school math, meaning universities may require four years.

The new statement made a difference, Freed believes. "That opened up conversations more at the high school level," he said. "That was a barrier to implementation, and so, by removing that barrier, now we have more high schools interested in modern math pathways."

[1] An eighth university enrolls graduate students only.

OTHER PROMISING STRATEGIES

OUR ANALYSIS UNEARTHED additional opportunities for K–12 and higher education systems to collaborate on streamlining students' math journeys.

North Carolina's **automatic enrollment policy**, adopted in 2018, responds to concerns that traditional, often subjective, placement methods, such as teacher recommendations or gifted screening, have excluded many qualified students, particularly those from historically underserved groups (Plucker et al., 2024). By placing students scoring at the highest level on state assessments into advanced mathematics courses the following year, automatic enrollment reframes advanced course access as a direct outcome of demonstrated academic performance—not as a function of local resources or discretionary screening (North Carolina General Assembly, 2018). The policy has demonstrated success in increasing equitable access to advanced coursework. By the 2022–23 academic year, more than 95 percent of North Carolina eighth grade students who scored at the highest level were placed in advanced mathematics courses, compared to 87 percent of eligible eighth graders in the prepolicy 2017–18 period (Maher et al., 2024).

The Virginia Community College System sought to ease the transition to college-level math courses by eliminating traditional placement testing in favor of **multiple measures assessment**, which bases students' placement on high school GPA and highest math course taken, and sometimes ACT and SAT test scores. For example, students with a GPA of 3.0 or higher and completion of Algebra II can enroll directly in college-level math courses. Students with a GPA between 2.0 and 2.9 and completion of Algebra II may enroll in college math courses with corequisite support (Virginia Community College System, 2025). Over an eight-year period, the proportion of entering students requiring developmental math dropped from 40 percent to 4 percent (Virginia Community College System, 2023).

Though each of these policy innovations was implemented by a single system—the North Carolina Department of Public Instruction and the Virginia Community College System—both present opportunities for other states' cross-system efforts to smooth the transition to college by eliminating barriers to course access.

RECOMMENDATIONS

This report has inquired into how state-level collaboration between K–12 and higher education systems can improve students' transitions from high school to college.

The emerging answer is encouraging: Collaborations across systems are not only possible but are already underway.

Partnerships that develop innovative math courses, align course content with college demands, and offer transparency in college admissions open doors for students who might otherwise face barriers, ensuring they learn math that will lead to success in college and in the workforce.

These strategies support several goals for advancing equitable high school math pathways:

+ **Expanding options** so that students can take high school and college math courses aligned with their interests
+ **Enhancing readiness** by increasing equitable access to advanced math courses for students who demonstrate readiness
+ **Eliminating barriers** by ensuring that students' high school coursework meets college expectations

Interviews made clear that most of the strategies apply across state contexts. They can also coexist within a given state: Our research uncovered no reason why higher education and K–12 systems could not collaborate on designing high school math sequences, aligning them with college policies, or expanding senior-year math courses that enhance college readiness or provide college credit. For example, in addition to using dual-enrollment courses to develop senior-year math course options and increase senior-year math coursetaking, Utah leaders also revised college placement to provide access to statistics and quantitative literacy courses for high school graduates with a C or higher in their math sequences.

K–16 mathematics alignment has the potential to strengthen student outcomes, but only when states address the complex challenges of coordination and equity. Doing so requires states to commit funding as well as staff time and expertise. Here are steps that K–12 and higher education systems can take with those investments to advance successful implementation of the key strategies and ensure that math courses support seamless transitions:

Establish and sustain active structures for collaborating across K–12 and higher education systems

The value of collaboration was emphasized repeatedly in interviews. Sustained collaboration involving all secondary and postsecondary systems can be a challenge to realize—but without it, effective implementation is elusive. The route to collaboration varied across our examples. Georgia's postsecondary math pathways, among the first in the nation, led the way to the K–12 system's redesign of high school mathematics. In Oregon, on the other hand, K–12 leaders spearheaded the effort to redesign high school math options, spurring the public universities to clarify their admissions requirements.

Georgia's and Oregon's examples underscore that sustaining K–16 collaborative structures requires long-term commitment: The history of collaborative efforts in both states dates back at least two decades (Callan et al., 2006).

California illustrates the challenges of fostering collaboration. Though the state is home to a significant degree of high school math innovation (Reed et al., 2023), the recent absence of a coordinating mechanism for higher education contributed to mixed signals from higher education about the status of some innovative high school courses. The faculty report on high school math preparation is a step toward stronger coordination, though greater K–12 involvement could have strengthened its impact.

In other states, policies with obvious K–16 implications were developed with little to no collaboration: North Carolina's automatic enrollment policy to ensure more equitable access to advanced math courses—a key metric for college admission—and Virginia's use of high school math records for college placement are strategies worthy of emulation, but they could benefit from cross-system collaboration.

There is limited research on how to ensure effective K–16 collaboration at scale, outside of specific successful policies, such as dual enrollment, or practices, such as course design. But it is clear that a math task force or working group is just the beginning. Though 31 states have such structures, *Charting the Course* found that some are more active than others (Charles A. Dana Center & Education Strategy Group [ESG], 2025). Often, these groups' recommendations depend on other governance bodies for implementation.

Our research suggests it is important that structures are ongoing and have clear accountability. Accountability requires participation of education system leaders who are empowered to make decisions regarding priorities, staffing, and funding. Coordinating structures also include relevant industry leaders, to ensure that mathematics pathways align with evolving workforce demands and emerging career fields.

Invest in research and develop robust K–16 longitudinal data systems to inform policy decisions and monitor effectiveness of programs

High-quality research based on robust data systems is necessary to ensure that policies are based on up-to-date evidence. Data systems are foundational for understanding and improving mathematics pathway effectiveness (Lee & Reyna, 2022). Higher education data provide critical feedback to K–12 systems about college outcomes such as remediation rates, course pass rates, and progress toward degree. That feedback, in turn, enables systems to refine policy and practice (Institute of Education Sciences, 2023). Accurate and timely data are also necessary to monitor equity goals, such as the goal envisioned by Oregon: student enrollment in each of the state's math pathways that mirrors the demographics of the state.

Measuring impact is easier when only one educational segment is involved. For example, Utah experienced increased enrollment in senior-year math courses, Georgia witnessed a rise in Algebra

I proficiency, and North Carolina saw increases in eligible students enrolling in advanced math courses in high school. However, such measures don't reveal the impact of those high school milestones on students' postsecondary outcomes, which is harder to assess: Does enrollment growth in senior-year math courses, increased Algebra II proficiency, and expanded access to advanced math courses translate into greater college success or more equitable two- and four-year degree completion across demographic groups?

Understanding how K–12 strategies affect postsecondary outcomes—and, ultimately, workforce outcomes—requires linking two or more data systems and employing more sophisticated analytical techniques.[2] Currently, only 10 states publicly report information on middle and high school math coursetaking (Charles A. Dana Center & ESG, 2025). Even fewer have the capacity to analyze students' transitions from high school to college.

In addition to establishing and sustaining data systems, states should support cross-system research partnerships to shed light on the effectiveness of policies and practices. Further analysis to eliminate unnecessary repetition is also in order, in light of research suggesting a two-thirds overlap between college algebra courses and foundational high school math content—including some content that is not meaningfully aligned with contemporary needs (Student Achievement Partners, 2025).

Support and sustain implementation—particularly through professional development—to ensure that policy designs translate into expanded access and meaningful classroom practices

Policy change alone does not change students' classroom experiences. State-level strategies need to be implemented at schools and colleges by administrators, counselors, and especially math instructors. Effective professional development for mathematics educators across K–12 and higher education involves ongoing, collaborative communities of practice that enhance pedagogical skills and deepen mathematical content knowledge (NCTM, 2021; Rasmussen et al., 2021; Student Achievement Partners, 2025). Cross-system partnerships can play a vital role in translating education policies into meaningful classroom practices and expanded student access to rigorous coursework (NCTM, 2024; Reed et al., 2023). Collaboration and data sharing foster continual instructional improvement and the exchange of innovative strategies, supporting a shift from gatekeeping and toward greater equity in access to advanced mathematics (Bryant & Knudson, 2025; NCTM, 2025; Voigt et al., 2021; Zazkis & Nuñez, 2015).

[2] See Reed et al., 2023, and Wainstein et al., 2023, for examples of this type of research.

Provide transparent information and effective advising to guide students and families in choosing their math courses and pathways

Transparent information and equitable advising demand coordinated investment across K–12 and higher education systems, not merely school-level initiatives. Students, families, counselors, and teachers require accurate, up-to-date, and accessible information about enrolling in mathematics courses (Charles A. Dana Center & ESG, 2025), yet nationwide structures often create uneven access to such guidance. Institutional policies and advising practices significantly shape whether students from diverse backgrounds can access and succeed in mathematics courses that open doors to their chosen fields (Burdman & Baker, 2023). Misaligned messaging between secondary and postsecondary institutions creates confusion about math pathways and college readiness (Burdman & Purnell, 2020).

While effective advising systems play a critical role in helping students navigate math course options (Bland et al., 2024; Burdman & Anderson, 2022), these systems must be designed to avoid replicating historical tracking practices that have limited opportunities for underrepresented students by placing students into "qualitatively different or lower levels of a mathematics course" (NCTM, 2018). Building coordinated, equity-focused advising structures requires sustained investment in professional development and cross-system communication systems.

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