RAND

Research Report

ELIZABETH D. STEINER, SAM MORALES, CHRISTINE MULHERN

Access to Mathematics Learning and Postsecondary Preparation Opportunities in High School

Findings from the 2023 American Mathematics Educator Study

KEY FINDINGS

- Mathematics course offerings vary by school characteristics. Access to algebra I, geometry, and algebra II was common nationally, but students in small schools, schools in which a majority of students were living in poverty, or schools in rural areas were less likely to have access to Advanced Placement mathematics courses than students in other settings.
- *Tracking*, a practice that groups students in mathematics courses by achievement level, was common in high schools nationally, especially in Florida. A large majority of high school principals said that they used teacher recommendations as one—but generally not the only—data source when making placement decisions.
- High school principals reported that many students participated in supplemental opportunities to learn math (e.g., supplemental math courses), but participation in career-oriented mathematics learning opportunities was less common.
- High school principals reported that student absenteeism and teacher staffing shortages were the biggest obstacles to promoting student learning in mathematics.
- According to high school principals, students generally received postsecondary transition supports from school counselors. The greatest perceived barriers to all students receiving postsecondary transition supports were student motivation and family preferences and beliefs.

Achievement in mathematics, particularly in advanced mathematics (e.g., trigonometry, precalculus, calculus, or Advanced Placement [AP] courses), is important for long-term college and career outcomes (Attewell and Domina, 2008; Byun, Irvin, and Bell, 2015; Long, Conger, and Iatarola, 2012). For example, students who participate in advanced mathematics courses are more likely to graduate high school; enroll in college or in science, technology, engineering, and mathematics (STEM) programs; complete college; and have higher incomes later in life (Attewell and Domina, 2008; Joensen and Nielsen, 2009; Long, Conger, and Iatarola, 2012; Tyson et al., 2007). However, many students do not take advanced mathematics courses. Data from the 2019 National Assessment of Educational Progress High School Transcript Study indicated that 43 percent of high school

students did not take mathematics courses beyond algebra II by the time they graduated (Nation's Report Card, 2019a).

These low rates of advanced mathematics course-taking are not wholly the result of student choice. Lack of access to advanced mathematics courses is also an issue: Many high schools do not offer advanced mathematics courses (Wolfe, Steiner, and Schweig, 2023). For example, students in small or rural schools are less likely to have access to advanced math courses than their peers in larger or more-urban schools (Anderson and Chang, 2011; Gagnon and Mattingly, 2016a; Irvin et al., 2017). And high schools that predominantly serve students from historically marginalized populations offer fewer opportunities to take advanced mathematics (Wolfe, Steiner, and Schweig, 2023).

Furthermore, there is inequity in access to advanced mathematics courses within schools. Students living in poverty and students who are Black or Hispanic are, on average, less likely to have access to and participate in advanced mathematics courses (Attewell and Domina, 2008; Irizarry, 2021). Some of these disparities stem from policies that place students into mathematics courses based on their perceived achievement levels; such policies are often referred to as *tracking*. Although tracking may be intended to ensure that students are exposed to appropriately challenging content, in practice it can limit access to advanced mathematics courses in high school based on early achievement levels; students who are Black, Hispanic, or from low-income households are particularly disadvantaged by tracking (McEachin, Domina, and Penner, 2020; Walston and McCarroll, 2010).

High school math experiences are also important predictors of college and career readiness. For instance, the math courses that students take in high school can influence the colleges to which students have access, the set of majors from which students can choose (Anderson and Burdman, 2022), and students' success in college and STEM pathways. More broadly, college and career success depends in part on access to high-quality supports for postsecondary transitions, but some evidence indicates that these supports might be unequally distributed. Many students have limited information about their postsecondary education and career options and how to pursue them, and students from lower socioeconomic backgrounds are less likely to have this information than their peers (Hoxby and Avery, 2013; Roderick et al., 2008). High school is one of the main places where students can access supports related to postsecondary transitions, but some research shows that the availability of such supports is lower in rural schools and for lower-achieving students (Gagnon and Mattingly, 2016a; Mulhern and Steiner, 2022).

These disparities in access to mathematics learning opportunities, mathematics achievement, college readiness, and postsecondary transition supports are not new and, in fact, grew during the coronavirus disease 2019 (COVID-19) pandemic, when student learning in mathematics suffered tremendously (Kaufman, Steiner, and Woo, 2023; Lee and Reeves, 2012; Mulhern and Steiner, 2022; Nation's Report Card, 2022; Nation's Report Card, 2019b). During the COVID-19 pandemic, the average student lost half a year of mathematics learning, ACT scores and other measures of college readiness declined, and achievement gaps widened (Fahle et al., 2022; "Fewer High School Seniors Ready for College as ACT Scores Continue to Decline," 2023).

Given the importance of mathematics achievement and the importance of postsecondary transition support for college and career success, many states and districts have implemented programs that are designed to improve equity of access to advanced mathematics content, boost student achievement in

Abbreviations

AMES	American Mathematics Educator Study
AP	Advanced Placement
ASLP	American School Leader Panel
COVID-19	coronavirus disease 2019
FAFSA	Free Application for Federal Student Aid
FRPL	free or reduced-price lunch
K–8	kindergarten through grade 8
K–12	kindergarten through grade 12
STEM	science, technology, engineering, and mathematics

mathematics, and reduce inequities in access to postsecondary supports.

One example of such a change is California's new math framework, which introduces an integrated mathematics sequence that combines geometry and algebra across three merged courses in addition to the traditional mathematics course sequence of algebra I, geometry, and algebra II (Schwartz, 2023). The goal of the integrated courses is to focus on applied problem-solving and the real-world relevance of mathematics, but many leaders and educators worry that this will not prepare students for STEM pathways in college (Conrad, 2023). The framework suggests taking algebra I in 9th grade rather than in 8th grade to address the negative consequences of tracking, but this change limits the advanced mathematics courses that students could take in high school.

In other examples, Texas, Washington, and North Carolina have implemented policies that automatically enroll qualified high school students in advanced mathematics courses; parents who do not wish their children to be so enrolled must opt their children out. Although the details of these policies vary across states (the Washington policy, for example, includes advanced courses in subjects other than mathematics), early research has found that more students who are Black or Hispanic/Latinx are enrolled in advanced mathematics courses after the implementation of such policies (Austin et al., 2022; Berg and Plucker, 2023; Gamboa, 2023).

In addition, state actions in Florida and Washington are focused on aligning mathematics course-taking with students' postsecondary education and career goals (Ivey, 2023; Napolitano, 2023), and many states are expanding advanced mathematics course offerings in high school through dual enrollment programs and online learning opportunities (Barshay, 2023; Hart et al., 2023; Rhine, 2022). Some schools have also invested in expanding tutoring supports for students (Arundel, 2022), an effort that is supported by the Biden administration (U.S. Department of Education, 2023). In addition, the Biden administration is investing in improving access to student data and in helping schools better use data to identify students who are in need of additional academic support (U.S. Department of Education, 2023).

Despite these efforts to improve access and equity of mathematics learning opportunities and postsecondary transitions, schools continue to face new and perennial challenges. For instance, students and schools are still struggling to recover from unfinished learning during the COVID-19 pandemic and widening achievement gaps (Fahle et al., 2023; Kuhfeld and Lewis, 2022; Peters et al., 2023). Student absenteeism is much higher than it was prior to the pandemic (Dee, 2023), and during the pandemic, many teachers reported that they were not able to devote as much time to mathematics instruction as they would have liked (Wolfe, Steiner, and Schweig, 2023). Increased teacher turnover and a lack of applicants for open positions have put additional pressure on existing staff (Nguyen, Lam, and Bruno, 2022; Steiner et al., 2022; Zuo, Huguet, and Steiner, 2023).

In light of what we know about inequities in students' math learning opportunities, education leaders and policymakers need timely information from principals about mathematics course offerings, practices for assigning students to mathematics courses, supports for students struggling in mathematics, and postsecondary preparation and career supports. This report presents timely and detailed information about access to and participation in mathematics instruction and postsecondary preparation supports

Education leaders and policymakers need timely information from principals about policies for assigning students to mathematics courses and supports for students struggling in mathematics.

across states and between different school settings using nationally representative principal survey responses from the American Mathematics Educator Study (AMES).

AMES was launched by RAND in 2022 to investigate the quality of kindergarten through grade 12 (K–12) mathematics teaching and learning across the United States. AMES surveys were administered to national samples of K–12 public school principals and mathematics teachers through the RAND American Educator Panels in spring 2023, and there are plans to administer surveys and to collect other data annually through 2027.

This report builds on the AMES research agenda outlined in Kaufman, Steiner, and Woo (2023) and provides a national view of the status of high school mathematics course-taking and postsecondary transition supports. It also details how access to different supports for learning mathematics and preparing for college and careers varies across school characteristics and across five focal states. We examine the following research questions:

1. What mathematics courses are offered in high schools?
2. How are students assigned to mathematics courses in high school?
3. What supplemental learning opportunities and supports are provided to high school students who are struggling in mathematics?
4. What do high school principals perceive as barriers to improving student achievement in mathematics?
5. What data do high school principals use to inform decisions about postsecondary advising supports, what supports do their schools provide, and what do principals perceive as barriers to supporting successful postsecondary transitions?

This report, which focuses on the survey responses of high school principals, is the second in a series of reports that explores the 2023 AMES data. The first report presents the responses of principals who serve kindergarten through grade 8 (K–8) on a similar set of topics (Kaufman, Covelli, and Holmes, 2024). Our findings provide critical information for education policymakers about potential ways to better support mathematics achievement and transitions to postsecondary education and careers.

This Report Focuses on High School Principals

In this report, we use data from the first administration of the AMES principal survey, which was fielded to a nationally representative sample of principals from the American School Leader Panel (ASLP) in spring 2023. (AMES also includes a nationally representative survey of mathematics teachers that was fielded using RAND's American Teacher Panel.) This report focuses on the reports of principals who serve high school grades and is a companion report to Kaufman, Covelli, and Holmes (2024), which focuses on the reports of teachers and principals of grades K–8. Therefore, this report includes recycled text from Kaufman, Covelli, and Holmes (2024), such as the descriptions of the AMES survey, administration, and weighting.

In total, the 2023 AMES data include responses from 2,934 teachers and 3,174 principals across all grades K–12 (a response rate of 49.8 percent of teachers and 32.5 percent of principals). Survey responses are weighted to be representative of the national population of K–12 mathematics teachers and principals. AMES oversampled mathematics teachers and principals at all grade levels in the four largest states—California, Florida, New York, and Texas—and oversampled high school principals in Texas and Washington. These oversamples are weighted to allow us to report state-representative averages for high school principals in those five states and compare them with nationwide averages. The oversampled states were selected by the funder to align with their research and grantmaking priorities.

This report focuses on *high school principals*, who we define as school leaders serving schools with, at a minimum, grades 10, 11, or 12. Therefore, we omitted principals who serve students in grades K–9, unless their schools also included students in grades 10, 11, or 12. We sometimes refer to our sample of principals as *high school principals* or *principals* in this report. The analytic sample for this report includes 1,023 principals. Table 1 shows the

weighted composition for each state oversample and key national school-level subgroups of principals included in our analysis.

This report offers a descriptive, exploratory analysis of national trends in access to mathematics learning opportunities for students and supports for student postsecondary transitions in schools that serve high school grades. The AMES survey covers a variety of additional topics that are related to mathematics teaching and learning, such as instructional practices and materials, professional learning and development, district leadership, and school culture.

We explored whether principals' survey responses differed across the country or within our five oversample states according to the characteristics of the schools in which they worked. These characteristics included locale, percentage of students living in poverty, percentage of students who identify as people of color, and school size, as defined in Table 1.

Many of these school characteristics overlap because of how the spatial distribution of wealth and poverty intersects with race and ethnicity, which we illustrate for our sample in Figure 1. The text to the right of each horizontal bar in Figure 1 details the percentage of schools for that locale that serve mostly students of color, that serve mostly students living in poverty, or that are small schools. For example, 55 percent of the high schools in our sample that are in rural or town locales are small, and 79 percent of urban schools in our sample serve a majority of students of color. Associations between poverty, student race or ethnicity, and other student population characteristics are well-documented elsewhere (Nowicki, 2018). The color-coding of the horizontal bars in Figure 1 shows the degree of overlap within a locale for the characteristics of the share of students of color and the share of students living in poverty in our sample. For example, roughly one-third of suburban schools and rural or town schools serve mostly students living in poverty, and just over half of suburban schools serve mostly students of color. We encourage readers to keep these broad patterns and nuances in mind.

Unless otherwise noted, we discuss only differences between focal states and all other states and among principal subgroups that are statistically significant at $p < 0.05$. Our results are strictly

TABLE 1

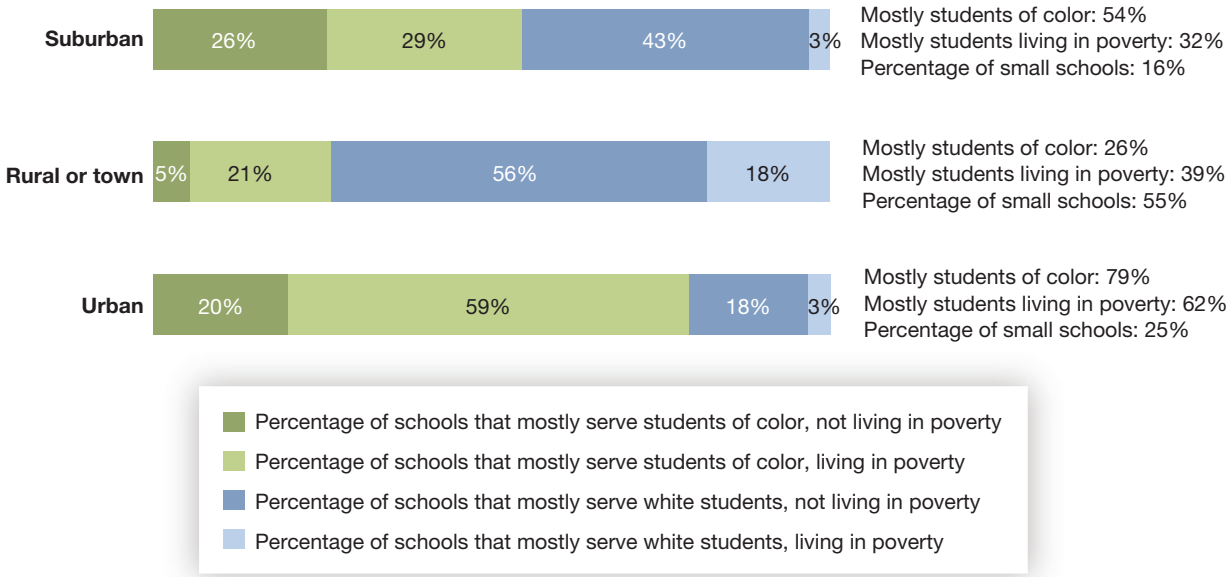
Percentage Distribution of Descriptive Characteristics of High School Principal Analytic Sample

Subgroup	High School Principals (%)
State oversamples	
California	8
Florida	3
New York	5
Texas	8
Washington	2
School characteristics	
Urban	22
Suburban	28
Rural	48
Low poverty	63
High poverty	37
Majority White students	59
Majority students of color	41
Small school	23
Large school	77

NOTE: The descriptive variables included in this table were merged with principal survey data from the 2021 Common Core of Data files using National Center for Education Statistics codes. Each value reports the nationally representative weighted percentage of principals in the sample that fall into a given subgroup. *Low poverty* is defined as less than 50 percent of students in a school qualifying for free or reduced-price lunch (FRPL). *High poverty* is defined as more than or equal to 50 percent of students in a school qualifying for FRPL. *Majority students of color* is defined as less than 50 percent of White students in a school. *Small schools* are defined as having fewer than 450 students. *Large schools* are defined as having 450 or more students. N = 1,023.

FIGURE 1

Relationship Between School Locale, Student Poverty Levels, and Student Body Racial or Ethnic Composition in the AMES 2023 High School Principal Sample



NOTE: This figure shows school-level characteristics by school locale based on the school leaders we surveyed (n = 1,023). The term *mostly students of color* refers to schools in which students of color make up 50 percent or more of the student population. *Mostly students living in poverty* refers to schools in which 50 percent or more of the student population is eligible for FRPL. Bars may not sum to 100 percent because of rounding. A similar figure, displaying similar patterns, is presented in Wolfe, Steiner, and Schweig (2023).

descriptive; these tests are not evidence of any causal effect of any state context or school characteristic on mathematics opportunities. For select results, we test the robustness of significant differences across principal subgroups to adjust for observable school-level characteristics (i.e., poverty level, racial and ethnic composition of student population, locale, and size). These regression analyses are useful for understanding drivers of differences, but we do not present regression-adjusted statistics for simplicity.

We present illustrative quotes that detail high school students' experiences with access to mathematics learning opportunities and postsecondary transition supports throughout this report in the Student Voice boxes. These data are drawn from three focus groups with a small convenience sample of high school students and recent graduates conducted in October 2023.

Readers should keep in mind that the survey data consist of information that is self-reported by principals, and we were unable to independently verify those responses. We were also unable to gather information about the quality (e.g., level of challenge, content covered) of the mathematics courses, supplemental supports, and postsecondary transition supports that we asked about in the survey. We hope future research will explore these topics. The analyses we present in this report address differences in access to mathematics learning opportunities and postsecondary transition supports across schools. The inequity of access within schools is equally important for education leaders and policymakers to understand and mitigate, but we were unable to address this topic in the AMES survey.

More details about our data, analysis, and limitations can be found in the "How This Analysis Was Conducted" section at the end of this report. The *American Mathematics Educator Survey: 2023 Technical Documentation and Survey Results* includes more details about sampling, survey response rates, and survey weighting and presents full descriptive data from the teacher and principal surveys (Schweig et al., 2023).

Mathematics Course Offerings

Nationally, Access to Algebra I, Geometry, and Algebra II Is Widespread, but Access to Advanced Mathematics Courses Is Uneven

Nine of ten high school principals nationally said that their schools offered algebra I, geometry, or algebra II onsite during the 2022–2023 school year, as shown in Figure 2. Access to these three courses, which are generally considered to be foundational for career preparation and success in advanced mathematics courses in high school and beyond (Achieve, 2020), was widespread across school characteristics. More than 85 percent of principals of urban, suburban, and rural schools; large and small schools; schools that served mostly White students and schools that mostly served students of color; and high- and low-poverty schools said that their schools offered these three courses.

We did not find statistically significant differences in reported offerings of algebra I, algebra II, or geometry by locale or percentage of students in poverty. Among principals of schools that served a majority of White students, 92 percent reported offering algebra II compared with 86 percent of principals who lead schools with a majority of students of color, a statistically significant difference.

Access to AP mathematics courses was less widespread and varied by school characteristics. Seventy percent of high school principals nationally said that their schools offered any of the AP classes we asked about and roughly half said that their schools offered calculus or AP calculus. Principals of large schools, suburban schools, and low-poverty schools were more likely than their counterparts to say that their schools offered AP courses. For example, 78 percent of principals of low-poverty schools said that their schools offered AP courses compared with 60 percent of principals of high-poverty schools.

Our findings confirm evidence from prior work that school size is a key driver of whether a school offers AP courses (Gagnon and Mattingly, 2016a; Nowicki, 2018). Differences in AP course offerings by school size, school poverty rates, and locale held even after controlling for other school characteristics.[1] These findings also confirm prior research that, nationally, students in small schools or in schools with a majority of the students living in poverty or in rural areas are in general less likely to have access to AP courses than students in other settings (Wolfe, Steiner, and Schweig, 2023).

Student Voice

Most students we spoke with said that course requirements at their schools left them with little choice in the mathematics courses they were able to take in high school.

> "[For] some of the math classes, it depended on the schedule, some were mandatory; we were required to take math all four years. But if you didn't take algebra II or geometry it could set you back a little bit."

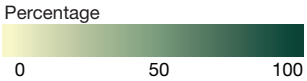
Math Course Offerings in the Five Focal States Generally Reflect High School Graduation Requirements

Large majorities—nearly 90 percent and higher—of high school principals nationally and in Florida, New York, Texas, and Washington reported that their schools offered algebra I, geometry, and algebra II onsite at their schools. A lower percentage of high school principals in California—roughly 65 percent—reported that these courses were offered onsite at their schools. High school principals in California were more likely than high school principals nationally to report offering integrated mathematics courses and some advanced courses (e.g., calculus BC, AP statistics) onsite at their schools, as shown in Figure 2. High school principals in Washington were more likely than their peers nationally to say that their schools offered business, consumer, general applied, technical, or functional mathematics and transition to college mathematics.

These patterns in reported course availability broadly reflect state high school graduation requirements. In Texas, students must complete algebra I, algebra II, and geometry prior to graduation, and Florida requires the completion of algebra I and

FIGURE 2

High School Principal Reports of Mathematics Courses Offered Onsite at Their Schools



Courses Offered	National	CA	FL	NY	TX	WA
Algebra I	90	65*	96	97*	98*	97*
Geometry	89	64*	98*	96*	98*	96*
Algebra II	89	64*	98*	94*	97*	96*
Any AP course	70	85*	79	79	70	54*
AP calculus, AB	62	78*	71	60	62	48*
Calculus	58	52	58	57	51	54
Computer science	47	40	38	45	43	43
AP statistics	47	72*	48	37	46	42
Statistics or probability	46	54	48	47	31*	23*
Trigonometry	46	42	32	48	23*	33*
Prealgebra	37	11	45	37	29	37
Business, consumer, general, applied, technical, or functional mathematics	36	28	26	38	21	58*
General mathematics	35	22*	37	41	35	30
AP computer science, A	35	41	46	43	38	24*
AP calculus, BC	32	52*	33	33	37	29
Review or remedial mathematics	23	19	34	29	32	23
Algebra III	21	12*	10	12	11	8*
Integrated mathematics I	18	37*	10	11	3	10*
AP computer science, AB	16	20	16	8	24	10
Transition to college mathematics	14	0*	12	13	19	30*
Integrated mathematics II or above	12	35*	3*	4*	2*	10
Discrete mathematics	9	4	3	3	2*	1
Calculus IB	6	14	7	2*	14	3
Quantitative reasoning	6	3	2*	0*	16*	0*
Analytic geometry	6	8	9	3	6	0*
Data science	4	25*	2	0*	0*	1

NOTE: AP = Advanced Placement; CA = California; FL = Florida; IB = International Baccalaureate; NY = New York; TX = Texas; WA = Washington. This figure shows the responses of principals who serve at least grades 10–12 and indicated that their schools offered the specified mathematics and computer science courses onsite. Included principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). N = 1,023. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. The survey question was, "This school year (2022–2023), which of the following mathematics and computer science courses are offered onsite at your school?"

geometry (Florida Department of Education, 2020; Texas Administrative Code, Chapter 74, Curriculum Requirements). California and Washington offer mathematics I or integrated mathematics I as an equivalent to algebra I and mathematics II or integrated mathematics II as an equivalent to geometry. High school students must complete algebra I and geometry or their alternatives prior to graduation. Washington school districts may also develop their own requirements (Washington Office of Superintendent of Public Instruction, undated). Students in California are required to complete two courses in mathematics to graduate; one of those courses must include algebra I or mathematics I (California Department of Education, 2023b). High school students in New York must take three credits of mathematics to graduate, all of which must be above the level of 8th grade mathematics (New York State Education Department, undated).[2]

Although students in California, New York, and Washington can fulfill their high school mathematics graduation requirements with courses with titles other than algebra I, geometry, or algebra II, relatively few principals in New York and Washington said that their schools offered those alternative courses. Ten percent or less of principals in New York and Washington reported that their schools offered integrated mathematics I or II. Forty-one percent of New York principals said that their schools offered general mathematics, but it is not clear from our data whether the content of this course would meet the state requirement of being higher than 8th grade mathematics. More principals in California—roughly one-third—reported that their schools offered integrated mathematics. This pattern is consistent with the state's recently adopted mathematics framework that codifies two course pathways: traditional and integrated (California Department of Education, 2023a). Within the five focal states, the differences reflected national patterns, and, similar to the national results, school size appeared to be a key driver of differences in access to AP courses.

Assignment to Mathematics Courses

Tracking Is Common, Especially in Florida

The practice of grouping students into mathematics courses, such as honors or career preparatory courses, by achievement level is sometimes called *tracking* (Gamoran and Mare, 1989; Oakes et al., 1990). We asked principals to choose one of three options to describe their school policy for grouping students into mathematics classes: by achievement level into different classes, by achievement level within mathematics classes, or no grouping by achievement level.

Just over half of high school principals nationally said that their school policy was to track students by achievement level into different classes, as shown in Figure 3. Twenty-one percent of principals said that their school policy was to group students by achievement level *within* mathematics classes (e.g., into small groups within a class), and 24 percent said that their school policy was not to group students by achievement level in mathematics. Tracking was most common in Florida, where 72 percent of principals said that their school policy was to group students into classes by achievement level. Tracking was least common in Washington, where only 34 percent of principals reported that it was their school policy.

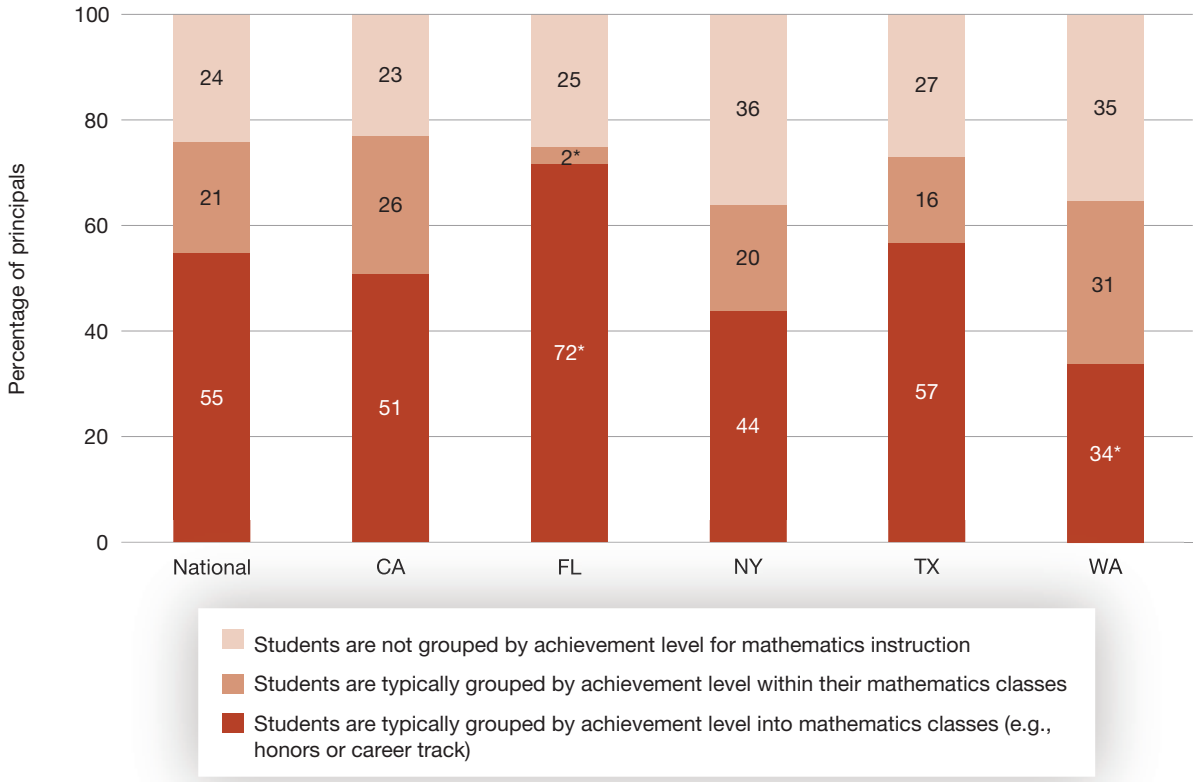
Student Voice

About half of the students we spoke with described fairly rigid tracking policies in their high schools, with few opportunities to change tracks once assigned. Most students felt that they should have input into which mathematics track they were placed in and be allowed to switch.

> "For us . . . if you start in the honors [math] track or get there you can stay, but if you are in [the] standard [track], you are kind of stuck there. We are allowed to go to our guidance counselor and ask for a specific class, but they weren't just gonna put you in it."

FIGURE 3

Percentage of High School Principals Who Reported School Policies That Group Students for Mathematics Instruction, Nationally and by Focal State



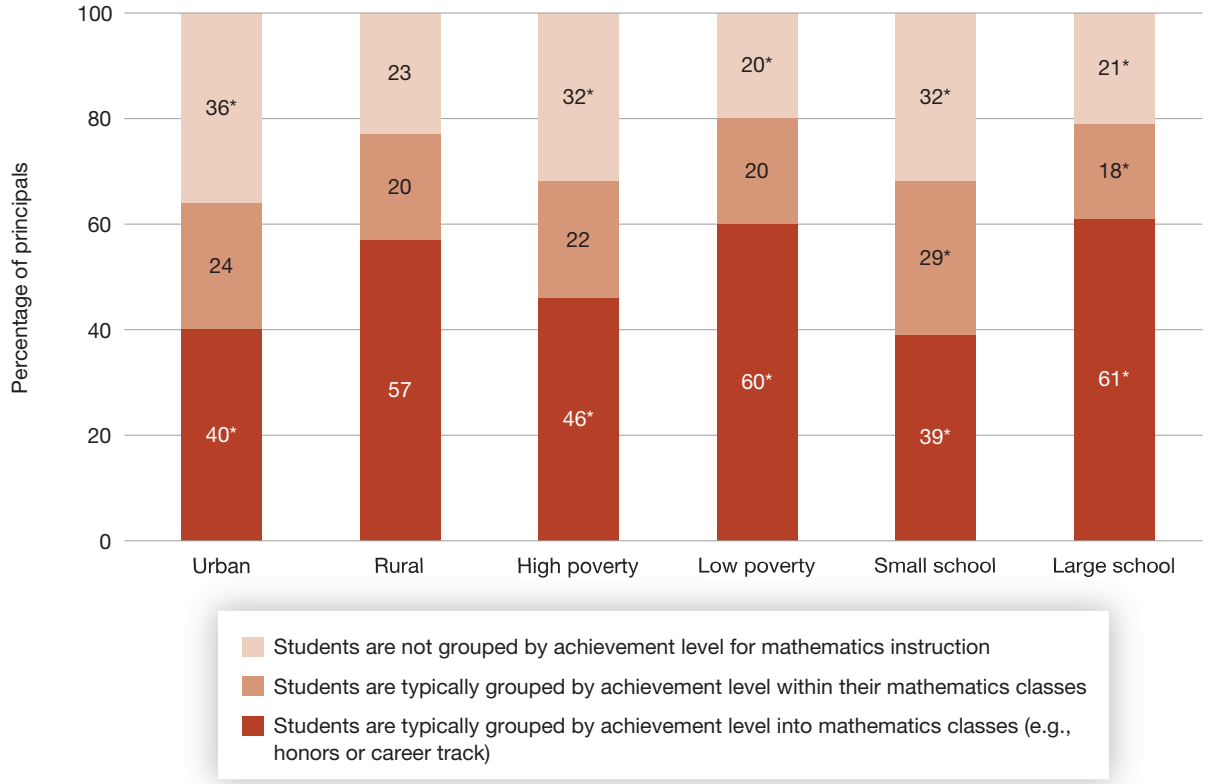
NOTE: This figure shows the responses of principals who serve at least grades 10–12. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). *N* = 973. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. Columns may not sum to 100 percent because of rounding. The survey question was, "Some schools organize mathematics instruction differently for students with different achievement levels. What is your school's policy about how students are grouped in the following grade bands?"

Tracking was reportedly more common in low-poverty schools, large schools, and suburban schools, as shown in Figure 4. Suburban schools were more likely to be low-poverty and large than high-poverty or small. For example, 60 percent of principals of low-poverty schools said that their school policy was to track compared with 46 percent of principals of high-poverty schools. Conversely, not grouping students into or within mathematics classes by achievement level was reportedly more common in urban schools, high-poverty schools, and small schools. For example, 32 percent of principals of high-poverty schools said that their school policy was not to group students by achievement level compared with 20 percent of principals of low-poverty schools.

Within California, New York, Texas, and Washington, differences in principal reports by school characteristics generally mirrored national patterns. Not all differences were statistically significant, likely because of small sample sizes. Contrary to patterns nationally and in the other focal states, tracking was reportedly more common in high-poverty high schools in Florida, while not grouping students by achievement level was more common in low-poverty high schools. Eighty-seven percent of principals of high-poverty schools in Florida reported that their school policy was to track students in mathematics compared with 51 percent of principals of low-poverty schools, a statistically significant difference. Forty-seven percent of principals of low-poverty

FIGURE 4

Percentage of High School Principals Nationally Who Reported School Policies That Group Students for Mathematics Instruction, by School Characteristic



NOTE: This figure shows the responses of principals who serve at least grades 10–12. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). N = 973. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. The survey question was, "Some schools organize mathematics instruction differently for students with different achievement levels. What is your school's policy about how students are grouped in the following grade bands?"

schools in Florida reported that their schools did not group students by achievement level in mathematics compared with 11 percent of principals of high-poverty schools. These differences remained statistically significant after we controlled for school characteristics (school poverty level, locale, size, and the racial and ethnic composition of the student population). Otherwise, Florida principals' responses were consistent with national patterns: Tracking was reportedly more common in large high schools and least common in urban high schools.

One possible explanation for the tracking patterns in Florida could be a state policy that requires high school students to take a remedial math course in addition to a regular math course if they scored below proficient on the prior year's math test. One result of this policy is classroom segregation by prior-year achievement level. Although the state no longer enforces this policy, many districts still follow this practice (Figlio and Ozek, 2024).

Principals Most Commonly Used Teacher Recommendations to Group Students by Achievement Level into Different Mathematics Classes

Nationally, 86 percent of high school principals whose school policy was to track students by achievement level into mathematics classes said that they used teacher recommendations to inform these groupings. Teacher recommendations were the most commonly mentioned data source among

the sources we asked about, as shown in Figure 5. Diagnostic or interim assessments and individualized education plans were the next most commonly reported data sources, followed by parent or family member requests and counselor recommendations.

Although teacher recommendations were the most commonly reported data source that principals used to group students by achievement level into mathematics classes, it was rarely the only source. Very few principals—just 2 percent—reported using only one data source. Principals reported using between four and five data sources on average, and 90 percent of principals reported that they used three or more data sources. Florida principals were relatively more likely to say that they used fewer data sources than principals nationally, possibly because of the widespread availability of state-required grade-level tests. There was no significant variation by school characteristics in the number of data sources that principals reported using.

In addition, Figure 5 shows that 78 percent of principals nationally who said that their school

FIGURE 5

Percentage of High School Principals Who Reported Using Different Types of Data to Group Students by Achievement Level into Mathematics Classes

Percentage

0 50 100

Type of Data	National	CA	FL	NY	TX	WA
Assessment data	85	69	100*	82	84	79
Diagnostic, benchmark, or interim assessments that measure students' achievement growth (e.g., MAP or STAR)	69	60	54	69	74	55
Required grade-level tests administered for accountability purposes	46	15*	87*	42	54	34
Tests or quizzes created by teachers or provided in curriculum materials	39	36	6*	56	37	52
Classroom tasks, assignments, or projects created by teachers or provided in curriculum materials	28	12*	18	49*	23	46
Recommendation data	92	95	69*	94	82	83
Teacher recommendations	86	95*	56*	78	70*	74
Parent, guardian, or family member requests	58	72	52	60	59	25*
Counselor recommendations	52	67	53	37	46	40
Own knowledge of the student	19	11	9*	22	26	19
Both assessment and recommendation data	78	64	69	76	71	62
Only assessment data	7	5	31*	6	13	17
Only recommendation data	14	31	0*	18	11	21

NOTE: The figure shows the responses of principals who serve at least grades 10–12. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). $N = 493$. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. The survey question was, "What data do you use to group students by achievement level into different mathematics classes?" The principals were instructed to select all that apply. This question was asked only of principals who said that their school policy was to group students by achievement level into mathematics classes.

policy was to track students in mathematics classes reported using both recommendations (e.g., from teachers or parents) and assessment data (e.g., required tests, diagnostic assessments) for those placement decisions. Roughly two-thirds to three-quarters of principals in each state said that they used both of these data sources. Even in Florida, where all principals said that they used assessment data, 69 percent said that they also used recommendations. California principals were more likely than principals in other states to use only recommendations to group students: 31 percent compared with 14 percent nationally.

California principals were most likely to say that they used teacher recommendations to group students by achievement level into mathematics classes, while Florida principals were most likely to say that they used required grade-level tests (see Figure 5). Washington principals were least likely to say that they used parent, guardian, or family member requests. There was little significant variation by school characteristic within the focal states. The relatively limited use of assessment data by California principals and their relative reliance on recommendations appear to run counter to the 2015 California Math Placement Act, which requires that high schools consider multiple measures of student performance—specifically assessment data and recommendations—when assigning students to math courses (State of California, Senate Bill No. 359, Chapter 508).

Supplemental Mathematics Learning Opportunities and Supports for Struggling Students

Instructional Time Was Similar Across States, Schools, and Courses

High school principals nationally reported that students at their schools received, on average, 4 hours and 25 minutes of instruction in algebra I per week, as shown in Table 2. This translates into roughly 53 minutes per day during a five-day school week. The reported average weekly instructional time was similar for geometry and algebra II. We did not find any significant differences in the reported average weekly instructional time for these courses by school size, locale, poverty level, or the racial and ethnic composition of the student population. Principals' reports of the average weekly instructional time in algebra I, geometry, and algebra II varied across states (Table 2). Principals in New York, Texas, and Washington reported that students received, on average, about 30 minutes less instructional time in these three mathematics courses than the national average. These differences likely reflect state requirements for the allocation of instructional time.

Student Voice

Most of the high school students we spoke with agreed that having multiple opportunities to get assistance helped them learn math, but some students said their schools lacked multiple options for such support. These students said that their teachers were available for extra help but, instead, most students took the initiative to access online options, such as YouTube videos, which were not as beneficial as in-person help.

> "We didn't have any of that . . . no formal tutoring [was] offered, but if teachers had capacity and scheduling time, they might stay after class a little bit."

High School Students Commonly Participated in Mathematics Courses at Other Schools or Online or Attended In-Person College Courses in Mathematics

Many students participate in opportunities to learn mathematics beyond taking courses at their high school. Majorities of high school principals nationally said that students at their schools participated in mathematics courses at another school or online, attended in-person college courses in mathematics, or joined field trips or other experiences that connect mathematics learning in class to real life, as shown in Figure 6. Participation in college courses in mathematics was most common, reported by 82 per-

TABLE 2

High School Principal Reports of Average Weekly Instructional Time in Mathematics in Hours and Minutes

Course	National	CA	FL	NY	TX	WA
Algebra I	4:25	4:15	4:10	3:51*	3:56*	3:59*
Geometry	4:18	4:14	3:59	3:47*	3:48*	3:58*
Algebra II	4:15	4:15	4:06	3:46*	3:50*	3:59

NOTE: This table shows the responses of principals who serve at least grades 10–12 who indicated that their schools offered the specified courses onsite. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). $N = 896$. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. The survey question was, "How much total mathematics instructional time do students at your school receive in a typical week in the mathematics courses offered at your school?"

cent of principals. Just over half of principals said that students at their schools participated in mathematics courses at other schools and in field trips and other real-life experiences related to mathematics. Students less commonly participated in such mathematics learning opportunities as mentoring, service learning, job shadowing, and independent study projects. For example, roughly one-third of principals nationally reported that students at their schools participated in mentoring programs related to learning mathematics.

Principals of rural schools were more likely than their counterparts to report that students at their schools participated in the mathematics learning opportunities we asked about. This difference remained statistically significant after we controlled for other school characteristics and may reflect the availability of local resources, such as in-school course offerings. In general, rural schools are more likely to have vocational-technical preparation and job shadowing programs, while more comprehensive school-based programs designed to help students make connections between academic learning and careers appear to be more widely available in urban schools (Hutchins and Akos, 2013). We do not know from our data whether the college courses that students participated in were online or in person.

Student participation in courses offered at another school or in college courses (online or in-person) was more common in Florida than in most other focal states, perhaps because of the presence of the Florida Virtual School or the state high school graduation requirement to take an online course. Participation in mathematics-related job shadowing or internships and field trips or related real-life learning experiences were less commonly reported by Florida principals and more commonly reported by New York principals, as shown in Figure 6.

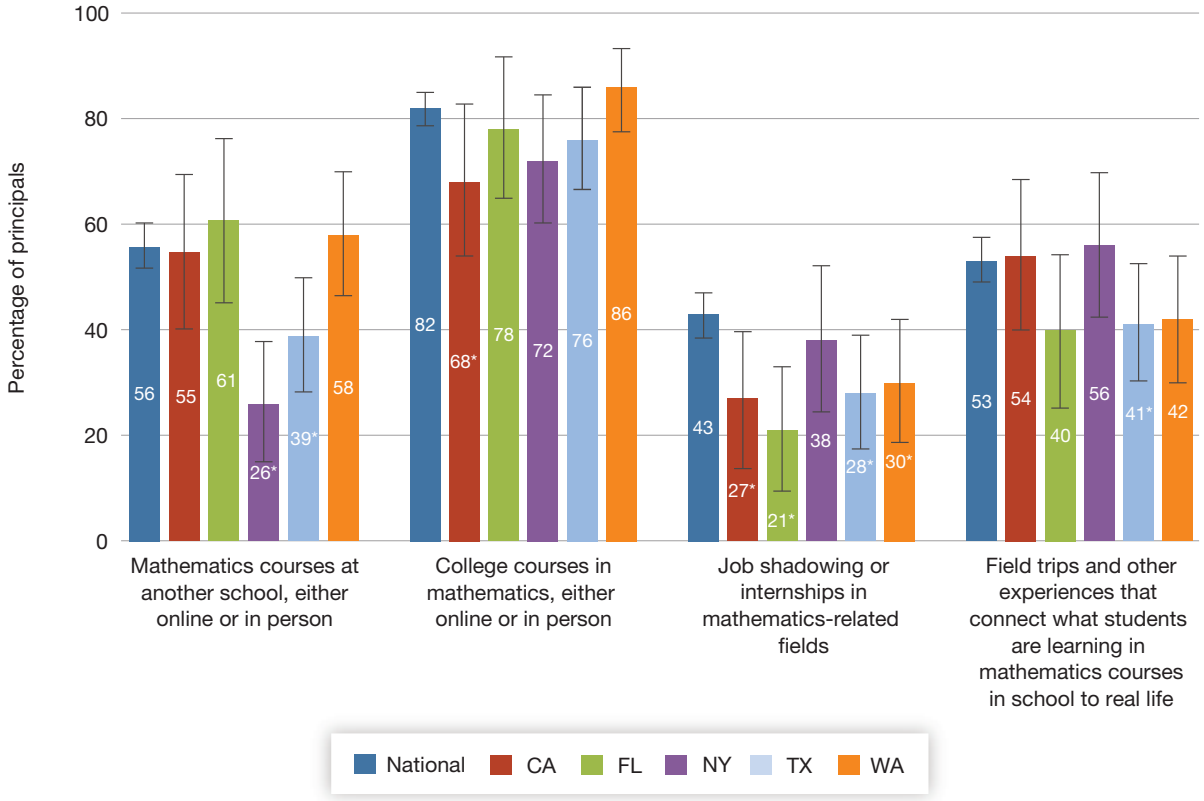
Programs to Support Students Struggling in Mathematics Were Common; Nearly All High School Principals Who Reported Offering Tutoring or Extra Help from Teachers Reported That Some Students Participated

Nearly all high school principals (96 percent) reported that their schools offered tutoring or extra help from teachers for students who were struggling in mathematics. A majority of principals also reported that their schools offered other supports for students struggling in mathematics, such as tiered programming or interventions, summer programs, catch-up courses, or small learning communities. Principals of schools with a majority of students of color were more likely to report that they offered summer programs and tutoring or extra help from teachers than principals of schools with a majority of White students. Washington principals were the least likely to report that they offered such supports.

Among principals who said that their schools offered these supports, most reported that at least some students who were struggling in mathematics participated. According to principals, students who were struggling in mathematics were most likely to have participated in tiered programming or tutoring

FIGURE 6

Percentage of High School Principals Who Reported Student Participation in Mathematics Learning Opportunities



NOTE: This figure shows the responses of principals who serve at least grades 10–12 and indicated that students at their schools participate in the specified opportunities for learning mathematics. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). N = 1,023. The error bars represent the 95 percent confidence interval of the estimates. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. The survey question was, "Have students at your school participated in any of the following opportunities for learning mathematics this school year? (2022–2023)"

and extra help from teachers, perhaps because those supports were commonly offered. About one-third of principals reported that most or almost all of their students who were struggling in mathematics participated in tiered programming or tutoring. More frequently, principals reported that less than half of their students struggling in mathematics participated in each of these supports.

Participation in programs for students struggling in mathematics was reportedly highest in small schools and high-poverty schools. Nationally, principals of high-poverty schools or small schools were more likely to report that most or almost all of their students participated in tiered programming or interventions for mathematics than their counterparts.

Principals of small schools were also more likely to report that all or almost all of their struggling students had participated in a summer program prior to middle or high school or had participated in small learning communities. In addition, principals of high-poverty schools or schools with a majority of students of color were also more likely to say that most or almost all students participated in catch-up courses or double-dosing of classes.

Obstacles to Promoting Student Learning in Mathematics

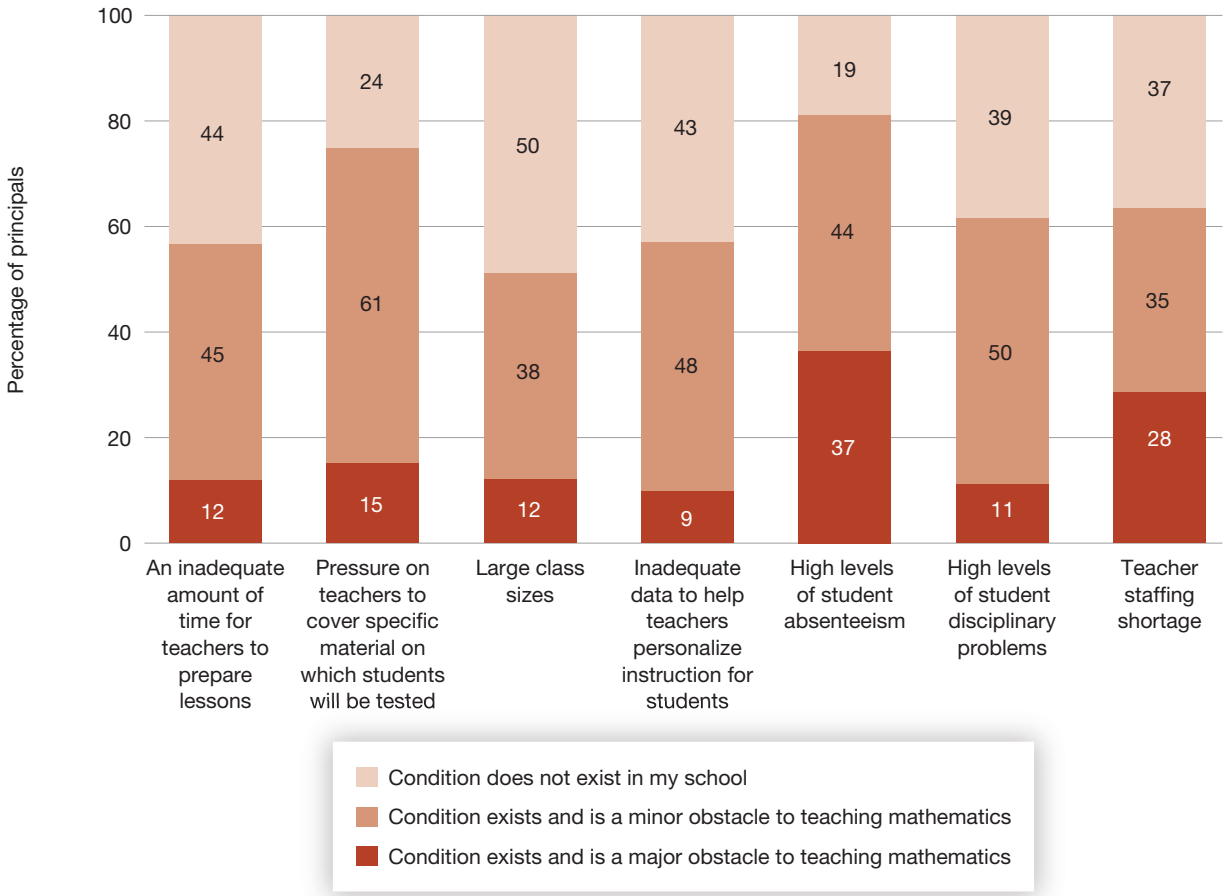
Principals Reported That Student Absenteeism and Teacher Staffing Shortages Were the Biggest Obstacles to Promoting Student Learning in Mathematics

One-third of high school principals reported that student absenteeism was a major obstacle to promoting student learning in mathematics, and one-quarter of principals cited teacher staffing shortages, as shown in Figure 7. These responses are unsurprising and reflect widespread concerns about chronic student absenteeism and difficulty hiring teaching staff (Dee, 2023; Nguyen, Lam, and Bruno, 2022). Consistent with prior research, our findings show that principals of high-poverty schools and principals of schools that served mostly students of color were more likely to report student absenteeism and staffing shortages as major obstacles than their counterparts (Dee, 2023; Zuo, Huguet, and Steiner, 2023). Differences by locale and school size were not statistically significant.

The most frequently reported obstacles to promoting student learning in mathematics differed across the five focal states. High student absenteeism was the most reported obstacle for high school prin-

FIGURE 7

Percentage of High School Principals Who Reported Obstacles to Promoting Student Learning In Mathematics



NOTE: This figure shows the responses of principals who serve at least grades 10–12 and indicated that a condition exists at their school and which condition is an obstacle to promoting student learning in mathematics. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). *N* = 1,023. Columns may not sum to 100 percent because of rounding. The survey item was, "Indicate whether the following conditions exist at your school and the degree to which each is an obstacle to you and/or your teachers' efforts to promote student learning in mathematics."

cipals in Washington state, 51 percent of whom said it was a major obstacle. In Texas, 44 percent of principals said teacher staffing was a major obstacle. The large percentage of Texas principals who responded that staffing struggles were a major obstacle is unsurprising. Texas experienced historically high teacher attrition between fall 2021 and fall 2022, and nearly one-third of teachers hired in Texas from 2022 to 2023 did not hold any type of Texas teaching certification or permit (Morath, 2023). In Florida, the most reported obstacle to promoting student learning in mathematics was pressure on teachers to cover specific material on which students would be tested, selected by 42 percent of high school principals. This result is unsurprising given the large number of end-of-course assessments administered in Florida. Although the survey item asked principals to select obstacles to promoting student learning in mathematics, the obstacles we asked about likely reflected school-wide challenges that are relevant across subjects.

Student Voice

Students voiced different challenges to their mathematics achievement than principals, stating that teachers taught to the test, spent too little time on fundamental skills or rushed through the content, and were disengaged. Students repeatedly mentioned the need to take responsibility for their own learning and that the teachers who cared about them acted as facilitators of learning.

> "I would say [not] working on foundational [mathematics] skills [was a barrier to my math learning]; sometimes we overlook elementary skills, but they carry on through every year. If you are missing basic info[rmation], it may affect your learning."

Supports for Postsecondary Transitions

Access to Disaggregated Data That Could Inform Postsecondary Preparation Supports Is Uncommon

Next, we shift to examining supports for postsecondary transitions. We focus on the data that principals reported using that might inform postsecondary preparation supports and the specific supports for postsecondary transitions that principals reported were offered at their schools. Disaggregated student-level data may help principals assess their students' needs and thus inform appropriate program selection and targeted provision of supports to students who need them the most.

About three-quarters of high school principals reported having access to at least one type of disaggregated student data, but access to some types of disaggregated data was uncommon. Access to disaggregated data on course-taking and on students at risk of dropping out were the most common, reported by 62 and 58 percent of principals, respectively. Access to data that could support postsecondary transitions, such as data on postsecondary advising, college applications and enrollment, and Free Application for Federal Student Aid (FAFSA) completion, was uncommon, reported by 23–39 percent of principals. Furthermore, roughly one-third of principals reported that they did not have access to any of the data sources (aggregated or disaggregated) that could support the postsecondary transitions that we asked about.

Nationally, there was little variation across school characteristics in principals' reported access to aggregated or disaggregated student data and the types of student data to which they reported having access.[3] However, there was some variation across states. Texas principals were significantly more likely to report access to disaggregated data on FAFSA completion than principals in other states, potentially because Texas requires all graduating high school students to complete the FAFSA. Principals in New York were more likely to report access to disaggregated postsecondary application and enrollment data than principals in other states, while Florida principals were less likely to report access to these data. In addition, Washington principals were most likely to report no access to data (aggregated or disaggregated) on postsecondary enrollments. These results suggest that there is potential to improve principals' access

to data that could help inform the supports their schools provide for postsecondary preparation.

Sixty-Two Percent of High School Principals Reported Using Disaggregated Student Data to Inform Planning or to Provide Postsecondary Advising

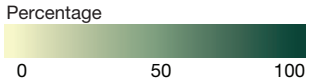
Principals with access to disaggregated student data most frequently reported using data on student grades or grade point average, postsecondary applications, postsecondary enrollments, and postsecondary advising to inform planning or provision of postsecondary advising (41–52 percent). Principals more commonly reported using disaggregated student data for other purposes, such as staffing decisions and setting goals for student learning, as shown in Figure 8.

A majority of principals reported using course enrollment data for staffing decisions and data on students at risk of dropping out or not progressing to the next grade to set goals for student learning.

Principals' reports of data use varied according to whether the data they had access to was aggregated or disaggregated. Principals who reported access to disaggregated student data were more likely to report using the data than those who reported having access to aggregated data. This was true across all data types and for any purpose. The relationship between access to disaggregated data and data use was particularly strong for data that could inform postsecondary transition supports. For instance, 89 percent of principals who reported having access to disaggregated postsecondary application data reported using those data compared with 66 percent of principals who reported having access to aggregated postsecondary application data. Overall, these results suggest that

FIGURE 8

Percentage of High School Principals Who Reported Using Each Type of Disaggregated Student Data for Decisionmaking



Type of Data	Setting Goals for Student Learning	Planning or Providing Postsecondary Advising	Staffing	Selecting New Programs or Partnerships	Evaluating Existing Programs or Partnerships	Do Not Use
Use of any disaggregated student data	70	62	69	64	66	
Student grades or GPA	67	50	27	34	43	7
Course enrollment data	37	32	69	37	47	8
Postsecondary application data	28	43	11	25	26	35
Postsecondary enrollment data	27	40	14	27	29	35
Data on social and emotional competencies	39	20	19	33	27	35
Data on specific students at risk of dropping out or not progressing to the next grade	65	39	33	42	42	10
Data on postsecondary advising (e.g., hours of advising, activities, activities students have participated in)	24	33	13	19	21	46
Data on student employment after graduation	18	26	10	22	23	52

NOTE: GPA = grade point average. This figure shows the responses of principals who serve at least grades 10–12 and indicated that they use specified data categories for various purposes, conditional on having access to any disaggregated data source. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). *N* = 773. The survey question was, "For which of the following purposes do you use these data?"

improving access to disaggregated data may be important for improving data use, particularly for informing postsecondary transition supports.

The survey also asked high school principals about a few key barriers to using student data to inform their decisionmaking in the 2022–2023 school year. Principals' most commonly reported barrier was that the data were not in a format that was easy to share or discuss with students' family members (41 percent). Across the focal states, Texas principals were generally less likely to report barriers to using student data than principals in other states. Principals of schools with a majority of students of color were more likely to report (1) that the data did not allow them to determine whether new mathematics curricula or interventions were needed and (2) that the data were not up to date compared with principals at schools with a majority of White students. There were no significant differences in reported barriers by locale or school poverty level.

Student Voice

The high school students we spoke with said that they learned about their options for mathematics courses and received their course schedules from school counselors. But the students noted that they received little information or guidance about which mathematics courses to take or how their course-taking decisions might connect to their lives after high school. In general, students thought that counselors should help students with these decisions. One student, who did work closely with a counselor on course-taking decisions, said working with a counselor was to her benefit:

> "My guidance counselor told me it would be more beneficial if I plan for certain things after high school, which forced me to take initiative and figure plenty of things out on my own."

College Preparation Supports Are Common Nationally; Career Preparation Supports Are Less Common

Most high school principals reported that their schools offered a variety of college preparation supports in the 2022–2023 school year. Figure 9 shows that 86 percent of principals reported that their schools offered counseling to help students understand the pros and cons of different post–high school pathways. A smaller share of principals reported that their schools offered internships and other work-based learning opportunities, opportunities for students to develop social networks to inform college and career choices, or specific curricula to support students' career exploration and planning. Thus, career preparation supports are reportedly less common nationally than college preparation supports.

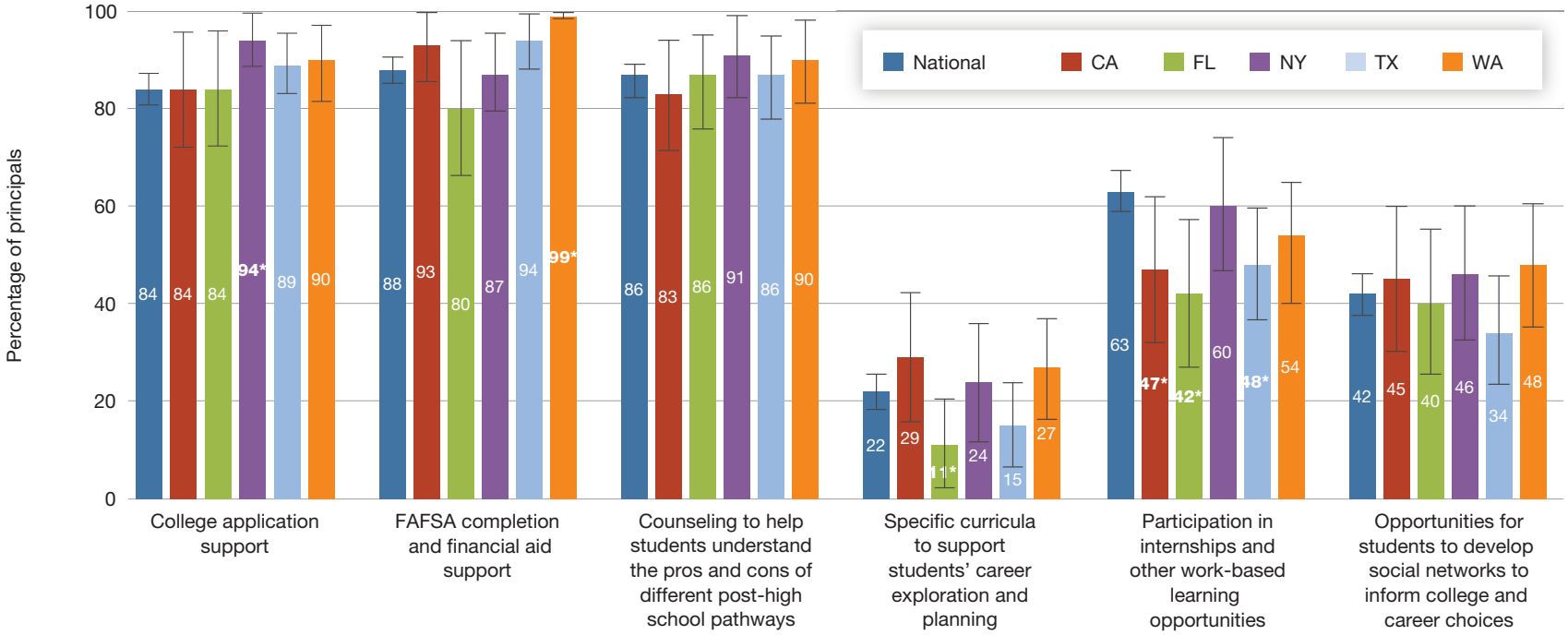
Nationally, there were some differences in which supports were offered by school characteristic. Principals from high-poverty schools and principals of schools with a majority of students of color were more likely to report that their schools offered FAFSA completion and financial aid support. However, principals from low-poverty schools and schools with a majority of White students were more likely to say that their schools offered participation in internships and other work-based learning opportunities.

Ninety-one percent of principals reported that one of the top three ways students received advising or support about college and career pathway options after high school was through scheduled one-on-one meetings with counselors, which was consistent with these reported types of college and career readiness support. Furthermore, 82 percent of principals reported that an on-staff counselor or advisor was primarily responsible for providing postsecondary transition supports to students. Only 20 percent of principals reported that students received advising or supports during a course specifically designated for supporting postsecondary education or career transitions, during an already scheduled academic course, or during out-of-school programming.

Nationally, principals of small schools were more likely to report advising and supports during a regularly scheduled advisory period or during a course specifically designated for supporting postsecondary education and career transitions; principals of larger schools were more likely to report providing supports

FIGURE 9

Percentage of High School Principals Who Reported That Their Schools Offer Supports for Postsecondary Education and Career Preparation



NOTE: This figure shows the responses of principals who serve at least grades 10–12 and indicated that the specified supports geared at postsecondary education and career preparation are offered at their school. These principals may also serve lower grades (e.g., if they are a principal at a K–12, 6–12, or 9–12 school). N = 1,023. The error bars represent the 95 percent confidence interval of the estimates. An asterisk (*) indicates that the state average is statistically significantly different from the average of the rest of the sample at $p > 0.05$. The survey question was, "During the current school year (2022–23), which of the following supports geared at postsecondary education and career preparation are offered at your school?"

through intermittent or stand-alone programming and school-sponsored activities to connect with social networks. Reports of advising and supports did not significantly vary by the poverty level or by the racial and ethnic composition of the student population of the schools.

Across states, most principals reported that scheduled one-on-one meetings with counselors was the way students at their schools received advising or support about college and career pathways. Principals in California were less likely to say that students received advising and support through a regularly scheduled advisory period than principals in other states. In Washington, principals were more likely to report supporting students through an advisory period than principals in other states. Principals in Washington were less likely to report advising and support through one-on-one meetings with counselors than principals in other states, and these rates were especially low in Washington's high-poverty schools.

Given the reliance on counselors for providing college and career readiness advising, it is important to ensure that counselors have sufficient time and expertise to support students. In most states, few principals—roughly 20 percent or less—reported that counselor training on college and career pathways and counselors' other duties were among the top three barriers preventing every single student from successful postsecondary transitions. Lack of student motivation and family beliefs or preferences about the pathway that students should pursue were the most common perceived barriers, identified by roughly two-thirds of principals nationally and in each state. Counselor training was more of a concern among California principals than among principals in other states. In Washington, principals were more likely to report that students needed additional college and career advising support beyond what was offered in their schools.

Across states, most principals reported that scheduled one-on-one meetings with counselors was the way students at their schools received advising or support about college and career pathways.

Summary

The survey responses from high school principals that we present in this report provide timely information about students' access to mathematics learning opportunities and postsecondary transition supports across the United States and in five focal states—California, Florida, New York, Texas, and Washington. This information can help education leaders and policymakers make informed decisions about possible mathematics course offerings, policies for grouping students, supports for students struggling in mathematics, and postsecondary preparation and career supports.

Principals' survey responses confirm that algebra I, geometry, and algebra II were widely available in high school and that the state differences in reported offerings were aligned with state-specific high school graduation requirements. Access to AP mathematics courses, which are generally not required for high school graduation, was uneven, with less reported access in small schools, schools with a majority of the students living in poverty, or schools in rural areas than in schools in other settings.

The practice of tracking—assigning students to math courses based on their prior achievement—is relatively common nationally. Roughly half of high school principals across the country reported that their school policy was to assign students to math

courses based on prior achievement. Tracking was most common in low-poverty schools, large schools, suburban schools, and in Florida. Within Florida, it was reportedly more common in high-poverty schools, in contrast with patterns seen in other states.

Although tracking can make scheduling simpler, especially in large schools, and may be used to ensure that students are learning content that is appropriately challenging, research on tracking has demonstrated that it is not implemented equitably in practice. Students who are Black, Hispanic, or from low income households tend to be placed in lower-level tracks more frequently than their peers (McEachin, Domina, and Penner, 2020; Walston and McCarroll, 2010). This practice is concerning because students in lower-track classes tend to receive less grade-level content, fewer opportunities to share their thought processes in class, and more teacher lecturing (Gamoran and Mare, 1989; Kaufman et al., 2012; Oakes et al., 1990; Schmidt, 2009).

Nearly all the principals in our sample (98 percent) who said that their school policies included tracking in mathematics reported using more than one data source to make decisions about how to place students into math classes. Most principals reported using a combination of teacher or parent recommendations and assessment data (e.g., benchmark or state-required assessments) to make these decisions. Although we were not able to explore why principals used multiple data sources, one possible reason could be that principals were following district policies, while another could be that principals were simply using the sources of data available to them.

Although tracking can make scheduling simpler, research on tracking has demonstrated that it is not implemented equitably in practice.

Principals' survey responses indicate that they are aware that many students need extra help in mathematics, and national pushes to expand tutoring appear to be taking hold—nearly all principals reported that their schools offered tutoring or extra help from teachers in math. But in most cases, principals reported somewhat low student participation in such supports, which could raise concerns that some students who are struggling in mathematics are not receiving the help they need. However, we were unable to examine the possible reasons for this reportedly low student participation in mathematics supports in a detailed way. Thus, it is unclear whether the reportedly low participation rates were related to the more-general barriers to supporting student mathematics achievement that the principals mentioned—such as staffing shortages or student absenteeism—or to other factors.

Echoing prior research, our data suggest that efforts to link high school mathematics learning to life after high school tends to focus more on preparation for college and less on preparation for a career (Boaler, 2016; Latterell, 2008; National Research Council, 2011). According to principals, postsecondary preparation supports offered by their schools generally tended to emphasize college preparation rather than career preparation. Although this emphasis may be related to research showing that a college degree is linked to economic success throughout adulthood (Oreopoulos and Petronijevic, 2013; U.S. Bureau of Labor Statistics, 2023a), there is increasing evidence that so-called middle-skill careers—particularly in STEM fields—that do not require a college degree may be able to support long-term economic success (Burrowes et al., 2014; U.S. Bureau of Labor Statistics, 2023b). High school principals also reported that access to disaggregated student data that could inform their provision of postsecondary supports was uncommon. This could be another reason why postsecondary career supports were relatively uncommon and suggests the potential to improve principals' access to data that could help inform the supports their schools provide for postsecondary preparation.

School counselors are shouldering the majority of student advising on postsecondary pathways, which is consistent with prior research (Clinedinst and Patel, 2018; Savitz-Romer, 2020). According to principals, the bulk of this advising occurs through one-to-one meetings between students and counselors. Although the AMES survey did not examine the quality of counselor supports, prior research suggests that access to high-quality counselors is important for student success, especially for historically disadvantaged students (Mulhern, 2023). Furthermore, students in high-poverty schools or schools with a majority of students of color tend to have the least access to school counselors (Gagnon and Mattingly, 2016b). Although the high school principals in this study were not as concerned about counselor workload or training as they were about student motivation and family preferences for postsecondary pathways, we know from other research that improving access to high-quality counselors can be important for students' high school and postsecondary success (Hurwitz and Howell, 2014; Mulhern, 2023).

In general, the differences in high school students' access to mathematics learning opportunities and postsecondary education supports within the five focal states mirrored national patterns.

Recommendations

These findings suggest several broad recommendations that district and school leaders and state education policymakers could consider, as well as directions for future research. In general, and with few exceptions, the differences in students' access to mathematics learning opportunities and postsecondary education supports within the five focal states mirrored national patterns.

Expand access to high school mathematics courses. In states that allow a variety of courses to meet high school graduation requirements, an expanded set of mathematics courses should be made available in more schools. However, it will be important to ensure that the key grade-level content is covered across all mathematics pathways and that state, district, or school policies governing the placement of students into mathematics courses are implemented equitably. It is also important to expand access to AP mathematics courses and supplemental learning opportunities for mathematics, particularly in small schools, non-suburban schools, and high-poverty schools. In settings where school size or staffing limit course availability, schools may be able to partner with other schools or colleges to offer online versions of advanced mathematics courses.

Ensure that decisions about the mathematics pathways or courses into which students are grouped (or tracked) are made equitably. Although 78 percent of high school principals use a mix of assessment data and recommendations (e.g., from teachers, parents, or school counselors) to place students in math courses, it is important to ensure that these data sources are used in a way that promotes equitable access to advanced math courses. District and school leaders should consider designing policies that ensure the consistent and transparent use of multiple data sources. District leaders should also consider training for principals to understand the mechanics of the policy and the inherent bias in various data sources, so that they can be prepared to correct for those biases when making course placement decisions.

Expand access to career preparation supports. Districts and schools could do more to connect students with mentors for college and career preparation and planning or invest in local partnerships for job shadowing programs. Districts and schools that have

limited geographic access or limited human or financial resources to provide these supports could consider virtual opportunities, other online options, or integrating career preparation with existing college preparation supports. Many principals reported that they lacked access to disaggregated student data related to postsecondary transitions and career supports; thus, expanding access to such data could help school leaders make informed decisions about the provision of high-quality career supports.

Identify ways to address the barriers that principals perceived to mathematics learning and postsecondary readiness. Better information-sharing with families about mathematics course pathways, course options and assignments, and postsecondary options and pathways may help mitigate perceived barriers related to family awareness or preferences. Schools should continue efforts to identify and address the underlying causes of student absenteeism and teacher shortages; these challenges will likely continue.

Conduct more research to better understand how to address the challenges highlighted in this report. For instance, recommendations to improve the equity of high school mathematics course assignment practices would benefit from a deeper understanding of how mathematics course assignment and advising happens in practice, how information about course availability and assignment is shared with students and families, which data are used to assign students to mathematics courses, and how tracking decisions are made. We will investigate these topics in future AMES surveys. We will also dig into these factors in our conceptual model related to teacher resources, including professional development, teaching materials, curriculum coherence, and more (Kaufman, Steiner, and Woo, 2023).

Limitations

Our findings are subject to several limitations. First, survey responses consist of self-reported information. Although it is a limitation present in all survey research, it is particularly salient for this research because we have no way to verify the accuracy of principals' reports of, for example, the mathematics courses or the supports for students who are struggling in mathematics offered at their schools. Second, some samples for the within-state subgroup estimates we discuss are small and could lead to imprecise estimates of differences across school characteristics. We attempt to mitigate this limitation by discussing only within-state differences that are statistically significant and encourage readers to be wary of drawing conclusions from differences that are substantively large but not statistically significant. Third, as we noted at the beginning of the report, this survey provides descriptive information about mathematics teaching and learning and postsecondary preparation based on high school principals' responses. Readers should not draw causal conclusions from the patterns we present in this report. Fourth, this report leaves important questions unanswered. For example, readers might naturally wonder about the quality of the mathematics courses, supplemental supports, or postsecondary advising supports that high school students have access to and participate in. Or readers might have questions about the extent of within-school inequities beyond the inequities across schools that we discuss in this report. These are important questions that were beyond the scope of this initial AMES survey. We hope to explore them in detail—and draw on other work in the field on these topics—as we continue our research.

How This Analysis Was Conducted

Each ASLP survey respondent was assigned a weight to ensure that the estimates reflect the national population of principals. Characteristics that factored into this process include descriptors at the individual level (e.g., gender, professional experience) and the school level (e.g., size, poverty level, locale, racial and ethnic composition of student population). At the request of the funder, the 2023 ASLP oversampled K–12 principals in California, Florida, and New York and high school principals in Texas and Washington. More information about ASLP survey sampling and weighting is available in our technical report (Schweig et al., 2023).

To compare responses for principals of schools with different demographic profiles, we matched principals' responses to school-level data from the 2021 Common Core of Data files from the National Center for Education Statistics. In this report, we compared high school principal responses across subgroups, defined by various school characteristics, and tested for whether average responses for certain subgroups differed from a specified reference subgroup. The school characteristics that we explored included the school's percentage of students eligible for FRPL, the racial and ethnic composition of the school's student population, school locale, and school size. We do not report exhaustively on all subgroup estimates on all survey items. We also compared responses for principals in each of the five focal states with the average in other states.

We used the percentage of students enrolled in FRPL as a proxy for student poverty level and characterized schools with greater than 50 percent student enrollment in FRPL as high poverty. We also determined whether a school served mostly students of color based on data that showed the percentage of White students enrolled at that school. We defined high schools as schools that include, at a minimum, grades 10, or 11, or 12. This definition included schools that served grades 9–12, K–12, grades 6–12, or grades 10–12 but excluded schools that served only grades 6–9 or grades 7–9. We defined small schools as schools that enrolled 449 students or fewer and large schools as schools that enrolled 450 students or more.

All estimates presented in this report are sample-wide or subgroup-specific estimates that are unadjusted for statistical controls. We used linear regression models to test whether estimates for a particular subgroup differ at the $p < 0.05$ level from estimates for the reference subgroup in that category without the use of any statistical controls. Estimates that are statistically significant at the 5 percent level are denoted with an asterisk (*) in this report's figures and tables. In some cases, we tested whether the differences are conditional based on school characteristics. In these models, we controlled for indicators of whether the school is urban or suburban, has a majority of students of color, has a majority of students in poverty, or is small (has fewer than 450 students). Because the intent of this report is to provide exploratory, descriptive information rather than to test specific hypotheses, we did not make statistical adjustments for multiple comparisons.

We also present data from three focus groups conducted in October 2023 with a small convenience sample of 18 current high school students and recent high school graduates. We partnered with BUILD, an organization that helps underserved high school students build entrepreneurship skills and engage in timely and relevant education policy topics.[1] BUILD staff identified possible focus group participants among their members and secured parental consent for students younger than 18 years of age. RAND staff recruited students, obtained assent or consent, facilitated the focus groups, and analyzed the data. The focus groups did not address all the topics included in the AMES surveys, and the data are not intended to represent the experiences of high school students nationally. Instead, they are meant to complement the principal survey data by illustrating some students' high school mathematics learning and postsecondary preparation experiences.

[1] See BUILD, homepage, undated.

Notes

[1] These estimates are from linear regressions of an indicator variable for offering AP courses on indicators for the school being in a rural or urban area, whether the school population consists of mostly students of color, whether the majority of students receive FRPL, and whether the school has fewer than 450 students.

[2] High school students in New York must also pass one mathematics Regents Examination—a statewide standardized test—to graduate.

[3] There were a few differences by school characteristic but no clear patterns. Principals of rural schools were less likely to have access to disaggregated course enrollment data and disaggregated postsecondary application data than principals of nonrural schools. Principals of urban schools were less likely to have access to postsecondary enrollment data and data on student employment after graduation than principals of nonurban schools. Principals of high-poverty schools were less likely to have access to course enrollment data and postsecondary enrollment data than their counterparts, and principals of schools with a majority of students of color were less likely to have access to postsecondary enrollment data, FAFSA completion data, and data on student employment after high school than principals of schools with a majority of White students.

References

Achieve, *The Algebra II Variable: State Policies for Graduation Requirements, Assessments, and Alignment to Postsecondary Expectations*, 2020.

Anderson, Rick, and Beng Chang, "Mathematics Course-Taking in Rural High Schools," *Journal of Research in Rural Education*, Vol. 26, No. 1, 2011.

Anderson, Veronica, and Pamela Burdman, *A New Calculus for College Admissions: How Policy, Practice, and Perceptions of High School Math Education Limit Equitable Access to College*, Just Equations, January 2022.

Arundel, Kara, "By the Numbers: The Post-COVID Growth of Tutoring," K–12 Dive, November 8, 2022.

Attewell, Paul, and Thurston Domina, "Raising the Bar: Curricular Intensity and Academic Performance," *Educational Evaluation and Policy Analysis*, Vol. 30, No. 1, March 2008.

Austin, Megan, Ben Backes, Dan Goldhaber, Dory Li, and Francie Streich, "Leveling Up: A Behavioral Nudge to Increase Enrollment in Advanced Coursework," National Center for Analysis of Longitudinal Data in Education Research, Working Paper No. 271-1022, October 2022.

Barshay, Jill, "Proof Points: High Schoolers Account for Nearly 1 out of Every 5 Community College Students," Hechinger Report, July 24, 2023.

Berg, Brenda, and Jonathan Plucker, "Why Your State Should Automatically Enroll Top Math Students in Advanced Classes," The 74, November 6, 2023.

Boaler, Jo, *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages and Innovative Teaching*, Jossey-Bass, 2016.

BUILD, homepage, undated. As of January 10, 2024: https://build.org/

Burrowes, Jennifer, Alexis Young, Dan Restuccia, Joseph Fuller, and Manjari Raman, *Bridge the Gap: Rebuilding America's Middle Skills*, Harvard Business School, November 2014.

Byun, Soo-yong, Matthew J. Irvin, and Bethany A. Bell, "Advanced Math Course Taking: Effects on Math Achievement and College Enrollment," *Journal of Experimental Education*, Vol. 83, No. 4, October 2015.

California Department of Education, "Mathematics Framework FAQs," webpage, July 5, 2023a. As of October 27, 2023: https://www.cde.ca.gov/ci/ma/cf/mathfwfaqs.asp

California Department of Education, "Mathematics Graduation Requirements," webpage, September 12, 2023b. As of October 27, 2023: https://www.cde.ca.gov/ci/gs/hs/hsgrmath.asp

Clinedinst, Melissa, and Pooja Patel, *2018: State of College Admission*, National Association for College Admission Counseling, 2018.

Conrad, Brian, "California's Math Misadventure Is About to Go National," *The Atlantic*, October 2, 2023.

Dee, Thomas S., "Higher Chronic Absenteeism Threatens Academic Recovery from the COVID-19 Pandemic," Center for Open Science, 2023.

Fahle, Erin M., Thomas J. Kane, Tyler Patterson, Sean F. Reardon, and Douglas O. Staiger, "Local Achievement Impacts of the Pandemic," Education Recovery Scorecard, October 28, 2022.

Fahle, Erin M., Thomas J. Kane, Tyler Patterson, Sean F. Reardon, Douglas O. Staiger, and Elizabeth A. Stuart, *School District and Community Factors Associated with Learning Loss During the COVID-19 Pandemic*, Harvard University, Center for Education and Policy Research, May 2023.

"Fewer High School Seniors Ready for College as ACT Scores Continue to Decline," ACT Newsroom & Blog, October 10, 2023.

Figlio, David, and Umut Ozek, "The Unintended Consequences of Test-Based Remediation," *American Economic Journal: Applied Economics*, Vol. 16, No. 1, January 2024.

Florida Department of Education, "Standard Diploma Requirements: Academic Advisement—What Students and Parents Need to Know," August 2020.

Gagnon, Douglas J., and Marybeth J. Mattingly, "Most U.S. School Districts Have Low Access to School Counselors: Poor, Diverse, and City School Districts Exhibit Particularly High Student-to-Counselor Ratios," University of New Hampshire, Carsey Research, National Issue Brief No. 108, Fall 2016a.

Gagnon, Douglas J., and Marybeth J. Mattingly, "Advanced Placement and Rural Schools: Access, Success, and Exploring Alternatives," *Journal of Advanced Academics*, Vol. 27, No. 4, November 2016b.

Gamboa, Suzanne, "Latino, Black Enrollment in Advanced Math Shot Up After States Made This Change. Should It Be a Model?" NBC News, October 7, 2023.

Gamoran, Adam, and Robert D. Mare, "Secondary School Tracking and Educational Inequality: Compensation, Reinforcement, or Neutrality?" *American Journal of Sociology*, Vol. 94, No. 5, March 1989.

Hart, Cassandra M. D., Robert Linden, Brian Jacob, and Susanna Loeb, "Online Course-Taking and Expansion of Curricular Options in High Schools," *Peabody Journal of Education*, Vol. 98, No. 1, 2023.

Hoxby, Caroline, and Christopher Avery, *The Missing "One-Offs": The Hidden Supply of High-Achieving, Low-Income Students*, Brookings Institution, Spring 2013.

Hurwitz, Michael, and Jessica Howell, "Estimating Causal Impacts of School Counselors with Regression Discontinuity Designs," *Journal of Counseling and Development*, Vol. 92, No. 3, July 2014.

Hutchins, Bryan C., and Patrick Akos, "Rural High School Youth's Access to and Use of School-to-Work Programs," *Career Development Quarterly*, Vol. 61, No. 3, September 2013.

Irizarry, Yasmiyn, "On Track or Derailed? Race, Advanced Math, and the Transition to High School," *Socius*, Vol. 7, January–December 2021.

Irvin, Matthew, Soo-yong Byun, Whitney S. Smiley, and Bryan C. Hutchins, "Relation of Opportunity to Learn Advanced Math to the Educational Attainment of Rural Youth," *American Journal of Education*, Vol. 123, No. 3, May 2017.

Ivey, Abbey, "Mathematics Pathways Updates," statewide email to Florida College System/State University System contacts, Florida Department of Education, May 2, 2023.

Joensen, Juanna Schrøter, and Helena Skyt Nielsen, "Is There a Causal Effect of High School Math on Labor Market Outcomes?" *Journal of Human Resources*, Vol. 44, No. 1, Winter 2009.

Kaufman, Julia H., Lauren Covelli, and Pierrce Holmes, *Elementary and Middle School Opportunity Structures Factoring into Students' Math Learning: Findings from the American Mathematics Educator Study*, RAND Corporation, RR-A2836-2, 2024. As of February 14, 2024: https://www.rand.org/pubs/research_reports/RRA2836-2.html

Kaufman, Julia H., Rita Karam, John F. Pane, and Brian W. Junker, "How Curriculum and Classroom Achievement Predict Teacher Time on Lecture- and Inquiry-Based Mathematics Activities," *Journal of Mathematics Education at Teachers College*, Vol. 3, No. 2, Fall–Winter 2012.

Kaufman, Julia H., Elizabeth D. Steiner, and Ashley Woo, *The American Mathematics Educator Study: Unraveling the Formula for Equitable and Excellent Mathematics Teaching and Learning*, RAND Corporation, PE-A2836-1, 2023. As of October 27, 2023: https://www.rand.org/pubs/perspectives/PEA2836-1.html

Kuhfeld, Megan, and Karyn Lewis, *COVID-19 in the Early Elementary Years: A Comparison of Achievement in Spring 2019 and Spring 2022*, Northwest Evaluation Association, Collaborative for Student Growth, October 2022.

Latterell, Carmen M., *Math Wars: A Guide for Parents and Teachers*, Rowman & Littlefield, 2008.

Lee, Jaekyung, and Todd Reeves, "Revisiting the Impact of NCLB High-Stakes School Accountability, Capacity, and Resources: State NAEP 1990–2009 Reading and Math Achievement Gaps and Trends," *Educational Evaluation and Policy Analysis*, Vol. 34, No. 2, June 2012.

Long, Mark C., Dylan Conger, and Patrice Iatarola, "Effects of High School Course-Taking on Secondary and Postsecondary Success," *American Educational Research Journal*, Vol. 49, No. 2, April 2012.

McEachin, Andrew, Thurston Domina, and Andrew Penner, "Heterogeneous Effects of Early Algebra Across California Middle Schools," *Journal of Policy Analysis and Management*, Vol. 39, No. 3, Summer 2020.

Morath, Mike, "Teacher Retention Data Reports, Certification Exam Reimbursements, and Teacher Talent Strategies," letter to administrators, Texas Education Agency, April 20, 2023.

Mulhern, Christine, "Beyond Teachers: Estimating Individual School Counselors' Effects on Educational Attainment," *American Economic Review*, Vol. 113, No. 11, November 2023.

Mulhern, Christine, and Elizabeth D. Steiner, *Changes in College and Career Readiness Supports During the First Year of the COVID-19 Pandemic*, RAND Corporation, RR-A827-5, 2022. As of October 27, 2023: https://www.rand.org/pubs/research_reports/RRA827-5.html

Napolitano, Jo, "Washington Recalculates Math Courses to Students' Career Relevance," Crosscut, September 22, 2023.

National Research Council, *Successful K–12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*, National Academies Press, 2011.

Nation's Report Card, "Achievement Gaps Dashboard," webpage, undated. As of October 27, 2023: https://www.nationsreportcard.gov/dashboards/achievement_gaps.aspx

Nation's Report Card, "2019 NAEP High School Transcript Study (HSTS) Results," webpage, 2019a. As of October 27, 2023: https://www.nationsreportcard.gov/hstsreport/#closerlook_0_0_el

Nation's Report Card, "NAEP Report Card: 2019 NAEP Mathematics Assessment," webpage, 2019b. As of October 27, 2023: https://www.nationsreportcard.gov/highlights/mathematics/2019/g12/

Nation's Report Card, "NAEP Report Card: 2022 NAEP Mathematics Assessment," webpage, 2022. As of October 27, 2023: https://www.nationsreportcard.gov/highlights/mathematics/2022/

New York State Education Department, "Regents Diploma Requirements for Mathematics," webpage, undated. As of October 27, 2023: https://www.nysed.gov/curriculum-instruction/regents-diploma-requirements-mathematics

Nguyen, Tuan D., Chanh B. Lam, and Paul Bruno, "Is There a National Teacher Shortage? A Systematic Examination of Reports of Teacher Shortages in the United States," Brown University, Annenberg Institute, EdWorkingPaper No. 22-631, August 2022.

Nowicki, Jacqueline M., *K–12 Education: Public High Schools with More Students in Poverty and Smaller Schools Provide Fewer Academic Offerings to Prepare for College*, report to the Ranking Member, Committee on Education and the Workforce, House of Representatives, U.S. Government Accountability Office, GAO-19-8, October 2018.

Oakes, Jeannie, Tor Ormseth, Robert M. Bell, and Patricia Camp, *Multiplying Inequalities: The Effects of Race, Social Class, and Tracking on Opportunities to Learn Mathematics and Science*, RAND Corporation, R-3928-NSF, 1990. As of August 8, 2023: https://www.rand.org/pubs/reports/R3928.html

Oreopoulos, Philip, and Uros Petronijevic, "Making College Worth It: A Review of Research on the Returns to Higher Education," National Bureau of Economic Research, Working Paper No. 19053, May 2013.

Peters, Scott J., Meredith Langi, Megan Kuhfeld, and Karyn Lewis, "Unequal Learning Loss: How the COVID-19 Pandemic Influenced the Academic Growth of Learners at the Tails of the Achievement Distribution," Brown University, Annenberg Institute, EdWorkingPaper 23-787, June 2023.

Rhine, Luke, "The Power of Dual Enrollment: The Equitable Expansion of College Access and Success," *Homeroom* blog, U.S. Department of Education, September 1, 2022.

Roderick, Melissa, Jenny Nagaoka, Vanessa M. Coca, Eliza Moeller, Karen Roddie, Jamiliyah Gilliam, and Desmond Patton, *From High School to the Future: Potholes on the Road to College*, Consortium on Chicago School Research, University of Chicago, March 2008.

Savitz-Romer, Mandy, *Fulfilling the Promise: Reimagining School Counseling to Advance Student Success*, Harvard Education Press, 2020.

Schmidt, William H., *Exploring the Relationship Between Content Coverage and Achievement: Unpacking the Meaning of Tracking in Eighth Grade Mathematics*, Education Policy Center, Michigan State University, 2009.

Schwartz, Sarah, "California Adopts Controversial New Math Framework. Here's What's in It," *EducationWeek*, July 12, 2023.

Schweig, Jonathan, Rakesh Pandey, David Grant, Julia H. Kaufman, Elizabeth D. Steiner, and Dorothy Seaman, *American Mathematics Educator Survey: 2023 Technical Documentation and Survey Results*, RAND Corporation, RR-A2836-1, 2023. As of January 10, 2024: https://www.rand.org/pubs/research_reports/RRA2836-1.html

State of California, Senate Bill No. 359, Chapter 508, California Mathematics Placement Act of 2015.

Steiner, Elizabeth D., Sy Doan, Ashley Woo, Allyson D. Gittens, Rebecca Ann Lawrence, Lisa Berdie, Rebecca L. Wolfe, Lucas Greer, and Heather L. Schwartz, *Restoring Teacher and Principal Well-Being Is an Essential Step for Rebuilding Schools: Findings from the State of the American Teacher and State of the American Principal Surveys*, RAND Corporation, RR-A1108-4, 2022. As of October 27, 2023: https://www.rand.org/pubs/research_reports/RRA1108-4.html

Texas Administrative Code, Chapter 74, Curriculum Requirements; Subchapter G, Graduation Requirements, Beginning with School Year 2012–2013; Section 74.73, Recommended High School Program.

Tyson, Will, Reginald Lee, Kathryn M. Borman, and Mary Ann Hanson, "Science, Technology, Engineering, and Mathematics (STEM) Pathways: High School Science and Math Coursework and Postsecondary Degree Attainment," *Journal of Education for Students Placed at Risk*, Vol. 12, No. 3, October 2007.

U.S. Bureau of Labor Statistics, "Employment Projections: Earnings and Unemployment Rates by Educational Attainment, 2022," webpage, September 6, 2023a. As of January 9, 2024: https://www.bls.gov/emp/chart-unemployment-earnings-education.htm

U.S. Bureau of Labor Statistics, "Occupational Outlook Handbook," webpage, September 6, 2023b. As of January 9, 2024: https://www.bls.gov/ooh/

U.S. Department of Education, "Biden-Harris Administration Announces New Actions to Build on Work to Accelerate Learning and Improve Student Achievement," fact sheet, September 13, 2023.

Walston, Jill, and Jill Carlivati McCarroll, "Eighth-Grade Algebra: Findings from the Eighth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K)," *Statistics in Brief*, National Center for Education Statistics, October 2010.

Washington Office of Superintendent of Public Instruction, "Mathematics Graduation Requirements," webpage, undated. As of October 27, 2023: https://ospi.k12.wa.us/student-success/resources-subject-area/mathematics/mathematics-graduation-requirements

Wolfe, Rebecca L., Elizabeth D. Steiner, and Jonathan Schweig, *Getting Students to (and Through) Advanced Math: Where Course Offerings and Content Are Not Adding Up*, RAND Corporation, RR-A827-10, 2023. As of October 27, 2023: https://www.rand.org/pubs/research_reports/RRA827-10.html

Zuo, George, Alice Huguet, and Elizabeth D. Steiner, *Principal Perspectives on School Staffing Struggles: Findings from the 2022 Learn Together Survey*, RAND Corporation, RR-A827-14, 2023. As of October 27, 2023: https://www.rand.org/pubs/research_reports/RRA827-14.html

Acknowledgments

We are extremely grateful to the educators who agreed to participate in the panels. Their time and willingness to share their experiences are invaluable for this effort and helps us understand how to better support their hard work in schools. We also deeply appreciate the input on the surveys and the report from our AMES advisory board, which includes Gregory Benoit, Nicole Joseph, Bea Moore, David Barnes, Bill DeBaun, Karla Robles, Patty Diaz Andrade, and Elisha Smith Arrillaga. We thank Alvin Nugroho, Brian Kim, and Dan Ibarolla for serving as the AMES survey managers; Julie Newell and Tim Colvin for programming the surveys; Ruolin Lu for serving as the data manager; and Dorothy Seaman for producing the sampling and weighting for these analyses. We appreciate the administrative support provided by Tina Petrossian and AEP management provided by David Grant. We also thank our reviewers, Megan Kufeld, Benjamin Master, and Umut Ozek, for helpful feedback that greatly improved this report. We thank Valerie Bilgri for her editorial expertise and Monette Velasco for overseeing the publication process for this report.

About This Report

In this report, we use data from the American Mathematics Educator Study (AMES) fielded in spring 2023 to kindergarten through grade 12 public school principals to describe high school students' access to and participation in mathematics learning opportunities and postsecondary transition supports. A companion report examines students' access to and participation in mathematics learning opportunities in kindergarten through grade 8.

The AMES surveys were fielded through the RAND American Educator Panels (AEP). The AEP are nationally representative samples of teachers, principals, and district leaders across the country. The panels are a proud member of the American Association for Public Opinion Research's Transparency Initiative.

If you would like to know more about the AMES dataset, please see *American Mathematics Educator Study Surveys: 2023 Technical Documentation and Survey Results* (RR-A2836-1, available at www.rand.org/t/RRA2836-1) for more information on survey recruitment, administration, and sample weighting. If you are interested in using AEP data for your own surveys or analysis or in reading other publications related to the AEP, please email aep@rand.org or visit www.rand.org/aep.

RAND Education and Labor

This study was undertaken by RAND Education and Labor, a division of the RAND Corporation that conducts research on early childhood through postsecondary education programs, workforce development, and programs and policies affecting workers, entrepreneurship, and financial literacy and decision-making. This report is based on research funded by the Bill & Melinda Gates Foundation. The findings and conclusions presented are those of the authors and do not necessarily reflect positions or policies of the foundation.

More information about RAND can be found at www.rand.org. Questions about this report should be directed to esteiner@rand.org, and questions about RAND Education and Labor should be directed to educationandlabor@rand.org.

www.rand.org