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Socioeconomic and Racial Discrepancies in Algebra Access, Teacher, and Learning Experiences: Findings from the American Mathematics Educator Study

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In this study, we highlight the differences in classroom-, teacher-, and school-level factors in 8th and 9th grade algebra experiences along socioeconomic and racial/ethnic lines using nationally representative survey data from the American Mathematics Educator Study. Several takeaways emerge from our analysis. First, we show that highest-poverty schools (i.e., schools in the top poverty quartile) are significantly less likely to offer algebra in 8th grade unconditionally (i.e., without needing to meet certain conditions) for all students or to offer algebra at all compared to lowest-poverty schools (i.e., schools in the lowest poverty quartile). Second, we find significant differences in which factors (e.g., parent requests, teacher referrals) are considered when placing students in advanced math courses in 8th and 9th grade that may affect the access of students from disadvantaged backgrounds to these courses or to more advanced pathways. Third, we show significant differences in 8th and 9th grade math teacher qualifications and classroom activities in math courses, with teachers in highest-poverty schools being significantly more likely to have received alternative credentials, less likely to have completed student-teaching during their preparation program, and less likely to have completed their state's licensure requirements for math. 8th and 9th grade math teachers in highest-poverty schools were also more likely to report that they spend more than half of their instruction time addressing math topics below grade level or addressing disciplinary issues. Mostly similar, albeit weaker, patterns emerge when we examine discrepancies along school racial/ethnic composition.

Offering 8th grade algebra in high-poverty school settings (or making it available to more or all students) could help close socioeconomic gaps in algebra enrollment in 8th grade and grant more equitable access to advanced math coursework in the long-run. That said, focusing on the provision of 8th grade algebra alone will likely not remedy the opportunity gaps in access to (and completion of) advanced math courses in high school since our findings suggest that highest-poverty high schools are also significantly less likely to offer college credit-bearing math courses. Further, our findings suggest that increasing the provision of algebra in 8th grade may present three challenges: (1) staffing these courses with qualified teachers; (2) providing strong supports for students who struggle with algebra; and, relatedly, (3) making algebra placement decisions that minimize failure and maximize success for the greatest number of students. Taken together, our findings demonstrate systemic inequities across racial/ethnic and socioeconomic lines in terms of access to, and experiences in, 8th and 9th grade math courses.

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Abstract

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Offering 8th grade algebra in high-poverty school settings (or making it available to more or all students) could help close socioeconomic gaps in algebra enrollment in 8th grade and grant more equitable access to advanced math coursework in the long-run. That said, focusing on the provision of 8th grade algebra alone will likely not remedy the opportunity gaps in access to (and completion of) advanced math courses in high school since our findings suggest that highest-poverty high schools are also significantly less likely to offer college credit-bearing math courses. Further, our findings suggest that increasing the provision of algebra in 8th grade may present three challenges: (1) staffing these courses with qualified teachers; (2) providing strong supports for students who struggle with algebra; and, relatedly, (3) making algebra placement decisions that minimize failure and maximize success for the greatest number of students. Taken together, our findings demonstrate systemic inequities across racial/ethnic and socioeconomic lines in terms of access to, and experiences in, 8th and 9th grade math courses.

Introduction

When and how algebra is taught remains one of the most controversial issues in education policy in the United States.[1] The outsized importance of algebra in the K-12 math curriculum stems from its role serving as the gatekeeper for more advanced math courses in high school (e.g., precalculus, calculus and AP math courses). A recent study in California suggests that taking algebra in 8th grade increases the likelihood of enrollment in advanced math courses in 9th grade by 30 percentage points and in 11th grade by 16 percentage points (McEachin, Domina, and Penner, 2020).[2] Furthermore, there is an established positive relationship between advanced math courses in high school and postsecondary and labor market outcomes (Attewell and Domina, 2008; Joensen and Nielsen, 2009; Long, Conger, and Iatarola, 2012; Tyson et al., 2007). For example, students who successfully pass those advanced math courses are more likely to persist through college and enjoy higher earnings post-high school (Joenson and Nielsen, 2009; Tyson et al., 2007).

That said, only a quarter of 8th graders nationwide took, and only one-fifth passed, algebra in 8th grade in 2021, according to the Civil Rights Data Collection of the U.S. Department of Education (U.S. Department of Education, 2021). Even more concerning are the disparities in 8th grade algebra enrollment and completion rates along racial/ethnic and socioeconomic lines. For example, 28 percent of White students nationwide took (and 25 percent passed) algebra in 8th grade whereas the enrollment and completion rates for Black or African

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[1] See, for example, https://www.nytimes.com/2024/05/21/opinion/algebra-math-racial-gap.html, accessed on 6/6/2024.

[2] In contrast, relatively little is known about the causal effects of successfully completing 8th grade algebra. That said, given the positive correlation between enrollment and completion, these estimated effects of algebra enrollment can be regarded as a lower bound for the causal effects of completion.

American students were only 16 and 13 percent respectively (U.S. Department of Education, 2021). These discrepancies likely contribute to the observed gaps in enrollment rates in Advanced Placement (AP) math courses in high school: while Black or African American students represent 15 percent of high school enrollment nationwide, they represent only 6 percent of high school students enrolled in AP courses in math (U.S. Department of Education, 2021).

States and school districts have implemented different algebra access/availability policies over the past two decades to address socioeconomic and racial/ethnic discrepancies in advanced course-taking in math in middle and high school. These include "universal algebra" policies that provide access to algebra in 8th grade for all students regardless of students' prior math achievement to close algebra enrollment gaps driven by differences in availability across school settings (e.g., Clotfelter, Ladd, and Vigdor, 2015; Domina et al., 2015); not offering algebra until 9th grade to reduce algebra readiness gaps by student socioeconomic status and race/ethnicity (Huffaker, Novicoff, and Dee, 2023); offering "double-dose" of algebra in 9th grade (Nomi and Allensworth, 2009; Cortes, Goodman, and Nomi, 2015) to improve algebra completion rates for lower-performing students; and, more recently, automatically enrolling higher-performing students in 8th grade algebra to alleviate concerns regarding availability of (and access to) 8th grade algebra for higher-performing students from disadvantaged backgrounds.[3] And there is extensive literature about the effects of these policies on student outcomes; on the whole, the research indicates that some of these approaches may yield better student outcomes than others.[4]

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[3] https://www.the74million.org/article/north-carolina-works-to-expand-access-to-advanced-math-courses/, accessed on 6/7/2024.

[4] For example, evidence on universal algebra policies suggests that these policies may increase algebra failing rates with little effect on overall math achievement (Clotfelter, Ladd, and Vigdor, 2015; Domina et al., 2015), whereas double dose of algebra in 9th grade has been found to improve student postsecondary outcomes.

In this study, we complement the existing literature by examining the classroom-, teacher-, and school-level factors that may influence algebra experiences using nationally-representative principal and teacher survey data from 2023 and 2024. To the best of our knowledge, this is the first study to examine socioeconomic and racial disparities in algebra access/availability, teacher attributes, and learning experiences at the national level in the United States. In our analysis, we pay particular attention to racial/ethnic and socioeconomic differences, which could help explain the observed discrepancies in algebra enrollment and completion rates. Our findings are informative for state and local policymakers and practitioners about the many ways that students may be systematically denied equitable access to mathematics. We specifically investigate the following factors in schools serving higher and lower shares of economically disadvantaged students and students of color.

Availability of (and access to) algebra in 8th and 9th grade: An important factor that could lead to discrepancies in algebra enrollment between student groups is differences in algebra offerings in different school settings. That said, even when algebra is offered, differences in access could emerge due to eligibility criteria. For example, if a school uses prior test scores in math as a criterion to enroll in algebra, racial/ethnic or socioeconomic differences in enrollment could emerge due to the test score gaps partly driven by the structural inequities in American society. In fact, in a recent RAND report, Kaufman, Covelli, and Holmes (2024) find that while 85 percent of principals nationwide reported that their schools offer algebra in 8th grade, only 20 percent stated that any student can participate in the course. In this report, we take a closer look at the availability of algebra in 8th and 9th grade; if it is not offered, we investigate what other math courses are offered; what criteria (if any) are used for students to be enrolled in algebra;

and math tracking practices in grades 6 through 8 with particular emphasis on disparities across school settings.

Teachers and classroom experiences in 8th and 9th grade math courses: Even with universal access to algebra for all student groups, discrepancies in completion rates could emerge due to differences in educational resources (or classroom experiences) available to students in algebra courses in different settings. For example, it is well established in the literature that students from disadvantaged backgrounds are less likely to have "high quality" teachers (as proxied by teachers' contribution to student test scores, teachers' education, experience, or advanced credentials) compared to more advantaged students (Clotfelter, Ladd, and Vigdor, 2005; Goldhaber, Lavery, and Theobald, 2015; Isenberg et al., 2013; Kalogrides and Loeb, 2013; Langford, Loeb, and Wyckoff, 2002; Sass et al., 2012). These differences may be particularly more pronounced in math given the longstanding teacher shortages in mathematics especially in schools serving higher shares of traditionally marginalized student groups (e.g., economically disadvantaged, students of color). We examine teacher and classroom experiences in 8th and 9th grade math courses (including algebra) along several measures: instructional time and background/education of teachers. We also examine the discrepancies in how teachers spend their time in the classroom in 8th and 9th grade math courses across school settings (i.e., school poverty and racial/ethnic composition).

For these analyses, we use data from the RAND American Mathematics Educator Study (AMES) administered to a nationally representative sample of K–12 public school principals and teachers in Spring 2023 and Spring 2024. Several takeaways emerge from our analysis.

First, our findings suggest that highest-poverty schools are significantly less likely to offer algebra in 8^{th} grade unconditionally for all students (i.e., student enrolling in algebra without needing to meet certain conditions such as prior math score requirements) *or* offer 8^{th} grade algebra at all compared to schools serving more affluent students compared to lowest-poverty schools. In particular, compared to principals in lowest-poverty schools, principals in highest-poverty schools (i.e., schools in the highest poverty quartile) were 12 percentage points less likely to report that their school offers algebra in 8^{th} grade unconditionally for all 8^{th} graders (this difference roughly corresponds to 25 percent of the mean for lowest-poverty schools). Similarly, principals in highest-poverty schools were four-times more likely to state that their school does not offer algebra in 8^{th} grade compared to principals in lowest-poverty schools. These differences remain virtually unchanged after controlling for the state in which the school is located, school urbanicity, and school size. Our findings do not reveal any significant differences in algebra availability in 8^{th} grade along the racial/ethnic composition of the student body in the school.

Second, our findings reveal important differences in factors schools consider when determining which students will be enrolled in algebra or more advanced math courses. For example, in highest-poverty schools, parental requests, teacher referrals, or prior course grades are less likely to be considered compared to lowest-poverty schools when placing students into advanced math courses. There are also important differences in how/whether achievement level is used in student grouping in middle school math courses: principals in highest-poverty schools were nearly three-times more likely to report that students are not grouped based on achievement level, and 12 percentage points (roughly equivalent to 40 percent of the mean for lowest-poverty schools) less likely to report that students are grouped across math courses based on achievement level. In contrast, achievement grouping *within* math courses (e.g., creating small groups in the same classroom based on student needs) is significantly more common in highest-poverty schools: principals in highest-poverty schools were twice as likely to report that they group students based on achievement level within math courses compared to schools in the lowest-poverty quartile. We do not find consistent patterns in across-course and within-course achievement grouping by the racial/ethnic composition of the school. These differences in achievement grouping could be driven by the differences in the availability of advanced courses: achievement grouping across courses may not be necessary in school settings where there is less differentiation in content across math classrooms.

Third, we find significant differences between teacher characteristics (e.g., pathways into teaching) in 8th and 9th grade math courses (grades when students most often take algebra) across school settings. For example, 8th and 9th grade math teachers in highest-poverty schools were nearly three times more likely to report that they completed an alternative certification program[5] compared to math teachers who work in schools that fall into the lowest-poverty quartile. This difference is even more pronounced when we compare schools based on student racial/ethnic composition: 8th and 9th grade math teachers in schools that serve the highest share of Black/Hispanic students were four times more likely to have completed an alternative certification program compared to math teachers in schools that serve lowest shares of Black and

[5] Alternative certification programs vary by state, but typically allow program participants to teach while they are completing their teacher coursework (instead of waiting until after they've completed all required coursework), or, have less stringent requirements than a traditional teacher preparation program (e.g., not requiring a bachelor's degree.

Hispanic students. Similarly, math teachers in highest-poverty schools were twice as likely to report that they did not student teach as part of their teacher preparation program, 20 percent less likely to be single-subject certified in math, and 10 percent less likely to report that they completed all teacher licensure requirements in math compared to math teachers in lowest-poverty schools. These differences in teacher characteristics may have implications for math teacher effectiveness in different school settings. Some prior research shows that teachers from highly selective alternative certification programs may be as effective as teachers that pursue traditional certification routes after two years in the classroom (Boyd et al. 2007), and that initial certification status may have minimal impacts on student outcomes (Kane et al. 2008). On the other hand, certain aspects of student teaching that are typical of traditional preparation programs (e.g., a capstone project where teachers relate curriculum learning to actual practices) are associated with higher teacher effectiveness (Boyd et al., 2006; Boyd et al., 2009; Ronfeldt et al., 2014), especially if the student demographics of teachers' current school are similar to the student demographics of the school in which they did their student teaching (Goldhaber et al., 2017).

Fourth, the findings reveal significant differences in classroom activities in math courses in 8th and 9th grades across school settings. Compared to math teachers in lowest-poverty schools, teachers in highest-poverty schools were 60 percent more likely to report that they spend more than half of their classroom time addressing topics below grade level; nearly three-times more likely to report that they spend more than half of their classroom time providing mathematics instruction verbally (excluding classroom discussion); twice as likely to report that they spend more than half of their classroom time taking a test or a quiz; and twice as likely to report that they spend more than half of their classroom time maintaining order/disciplining students. Similar patterns emerge in almost all cases when we compare schools based on student racial/ethnic composition – with teachers and principals in schools that serve a majority of students of color reporting patterns similar to those in the highest poverty schools.

Our findings demonstrate systemic inequities by race/ethnicity and socioeconomic status across several dimensions of the 8th and 9th grade math experience including availability of courses, teacher qualifications, and time devoted to grade-appropriate content. These findings have several important policy implications. For example, they imply that discrepancies in availability of 8th grade algebra across school settings is likely an important contributor to the observed differences in algebra enrollment along student socioeconomic status. As such, providing students with more access to 8th grade algebra could allow more students from disadvantaged backgrounds to take algebra in middle school and subsequently access more advanced coursework in high school. That said, it is important to note that 8th grade algebra is only one piece of the puzzle in closing the opportunity gaps in access to advanced math courses. For example, our findings also suggest that highest-poverty high schools are nearly half as likely to offer AP Calculus or AP Statistics (two courses that students who pass 8th grade algebra typically take by the end of 12th grade) compared to lowest-poverty high schools. Furthermore, providing access to algebra in 8th grade for students who are underprepared could also lead to negative outcomes (e.g., course failure, lowered student expectations for their performance) (Stein et al., 2011). Therefore, providing access to 8th grade algebra alone will likely not remedy concerns regarding opportunity gaps in access to (and completion of) college credit-bearing math courses in high school, which have been shown to be beneficial for students in the long run (Joenson and Nielsen, 2009; Tyson et al., 2007).

Further, our findings suggest that increasing access to algebra in high-poverty school settings may present three challenges: (1) staffing these courses with qualified teachers; (2) providing strong supports for students who struggle with the algebra; and, relatedly, (3) making algebra placement decisions that minimize failure and maximize success for the greatest number of students. Math teacher shortages are well-documented in high-poverty school settings (e.g., Sutcher et al., 2019). Our findings also show significant differences in the qualifications of 8^{th} and 9^{th} grade math teachers between high- and low-poverty schools: As such, offering more advanced math courses, which are more likely to require "math-specialist" teachers, could impose additional staffing burdens in high-poverty schools. In fact, this is a challenge many rural school districts face when staffing advanced math courses in middle and high school (e.g., Gao and Adan, 2016).

Additionally, one-third of the 8^{th} and 9^{th} grade math teachers in highest-poverty schools nationwide report that they spend more than half of their instructional time addressing topics below students' grade level. This could be exacerbated in advanced math courses if they are offered unconditionally to all students. As noted by Stein et al. (2011), when universal algebra has been instituted in a range of settings, the numbers of students passing algebra goes up, but so does the number of students failing algebra; in addition, algebra pass rates also typically decline slightly likely because more students who struggle in mathematics are enrolled in algebra courses. These data and our own survey data therefore indicate that students from different racial/ethnic and socioeconomic backgrounds are not equitably prepared to pass algebra in 8^{th}

grade, even if it is offered universally. For these reasons, we posit that any state or school system instituting policies that increase the numbers of students taking algebra in 8th grade should be accompanied by strong supports for students who may struggle with algebra content, as well as strong supports for teachers who may struggle to differentiate algebra instruction to meet the diverse needs of students.

One approach that has been shown to have positive effects on student outcomes is providing a double-dose of algebra, whereby algebra is offered to all students while, at the same time, students who are deemed not ready are provided additional instruction time to address their educational needs (Nomi and Allensworth, 2009; Cortes et al., 2015). That said, important concerns remain about the unintended tracking consequences of this approach, especially for Black and Hispanic students (Figlio and Ozek, 2024), and their crowding out effects (i.e., which courses students forfeit to compensate for the additional instruction time in algebra).

Another approach to ensure that most students experience success with algebra could also be to ensure the highest proportion of students who can handle algebra coursework are enrolled in the course, and those who would struggle the most and potentially fail are not enrolled in algebra too early. Our data indicates that schools with different levels of resources use different types of data to place students in mathematics courses (e.g., principal knowledge is a greater factor for placement in highest-poverty schools, whereas parental requests, teacher referrals or prior course grades are more of a consideration in lowest-poverty schools), which could create biases in which students have access to algebra and other advanced mathematics courses. To decrease potential biases, states and school districts could consider requiring multiple sources of data to place students, as well as integration of data from assessments that are specifically intended to support algebra placement decisions. For example, Dougherty et al. (2015) observed less inequities in who takes algebra in 8th grade when districts use high-quality, rigorous mathematics assessments to help determine students' placement into math courses.

There are several important limitations of our analysis. For example, we are only able to examine the variation in algebra access, teacher qualifications, and classroom experiences across schools. However, it is plausible to expect that there is significant variation along these dimensions within schools between student groups (e.g., by student economic disadvantage or race/ethnicity): For example, there is extensive literature documenting the within-school variation in teacher effectiveness (e.g., Sass et al., 2012). As such, our findings only portray a partial picture about these socioeconomic and racial/ethnic disparities at the individual level. Second, our analysis on classroom activities relies on self-reports teachers, which may be reported with error. That said, our results should not be affected if this error does not vary across school settings (i.e., teachers in different school settings are equally likely to misreport classroom activities).

Data and Empirical Strategy

To address our research questions, we use data from the first two administrations of AMES. RAND administered these surveys to nationally representative samples of teachers and principals from the American Teacher Panel (ATP) and American School Leader Panel (ASLP) in spring of 2023 and 2024 (Schweig et al., 2023; Schweig et al., Forthcoming). Across all grades K-12, the principal survey has completion rates of 32.5 and 29.3 percent while the teacher survey has completion rates of 49.8 and 46.7 in 2023 and 2024 respectively.[6] In our analysis, we focus on 8th and 9th grades (grades when students most often take Algebra I), so we restrict the principal sample to those who reported that their school serves 8th or 9th grade and the teacher sample to those who reported that they were teaching a math course in 8th or 9th grade. These restrictions leave us with 3,102 unique principals and 999 unique teachers across the two years. We use this pooled data in our main analysis except in cases where the survey question of interest was included in one year only.

We supplement these data with school-level characteristics such as urbanicity, student composition, grades served, school size from 2021 Common Core of Data (CCD), and a school-level poverty measure recently generated by the Urban Institute: model estimates of poverty in schools (or MEPS).[7] Our primary goal in this report is to examine heterogeneities along two measures: school poverty and student racial/ethnic composition. As such, we execute our analysis by dividing teachers and principals into four quartiles based on their school poverty and the share of Black or Hispanic students they serve.

We present four sets of results. In the first set of models, we show raw comparisons between the school quartiles. In the second set of models, we include state fixed-effects to examine the extent to which observed discrepancies are driven by state-level factors including differences in education policy. In the third set of models, we control for school location (urban, suburban, rural) and school size to account for potential differences based on urbanicity and

[6] More technical details about the AMES surveys can be found in Schweig et al. (2024), Kaufman et al. (2024), and Steiner et al. (2024).

[7] More information on MEPS, including a technical report, can be found in Gutierrez, Blagg, & Chingos, 2022, https://www.urban.org/research/publication/model-estimates-poverty-schools.

school size. Finally, we control for other school-level characteristics including school racial composition (in analysis where we examine socioeconomic disparities) or school poverty (in analysis where we examine racial/ethnic disparities). Survey weights are used as probability weights in pooled regressions such that the pooled sample mean is equal to the pooled population mean over years 2023 and 2024. For more information about how these surveys were weighted, see Schweig et al. (2024). Given that some principals and teachers participated in both years of the survey, we cluster all standard errors at the school level. In what follows, unless otherwise noted, statistical significance implies significance at the 5 percent level. In addition to this national analysis, Appendix C also presents results from three large states (California, Florida, and Texas) where we gathered survey data from oversamples of teachers and principals.

Results

We present our main findings in Figure 1 to Figure 9 (and in figures in Appendix A) while we provide the numbers behind these figures in Appendix B. In each figure, the left panel presents the estimated difference in the outcome of interest between schools in second, third, and top poverty quartiles and schools in the bottom quartile obtained using the four specifications described above while the right panel presents the results from the same analysis using schools' racial/ethnic composition.[8]

Algebra Availability and Access

We first examine the differences in availability of, and access to, algebra in 8th and 9th grade by school poverty and racial/ethnic composition. We do this by investigating course

[8] The least impoverished schools and schools with smallest shares of Black/Hispanic students are schools in quartile 1. These schools serve as the reference category in these regressions and are not shown in the figures. Means for the reference category are reported in parentheses in the heading of each panel in all figures.

offerings, eligibility criteria for course access, and achievement grouping practices. Data in this section come from principal survey data pooled across the two survey administrations which allows us to investigate the following topics related to algebra availability and access: (1) whether algebra is offered in 8th and/or 9th grade[9], and if so, which students can participate; (2) if only some students can participate in algebra, which factors are considered to determine eligibility; (3) whether students are grouped by achievement level for mathematics instruction in middle school and/or high school, and if so, whether students are grouped within math courses or across math courses; and (4) in addition to (or instead of) algebra, what other math courses are offered to middle-school and high-school students.

Panel (A) of Figure 1 shows the differences in the likelihood that the school offers 8th grade algebra *and* any student can participate by school poverty quartiles while Panel (C) examines the differences in the likelihood that the school does not offer 8th grade algebra (Appendix Table 1A provides the numbers). We find that highest-poverty schools are 12 percentage points less likely to offer 8th grade algebra unconditionally as compared to lowest poverty schools. This is a sizable difference that roughly corresponds to 25 percent of the mean for lowest-poverty schools (means for the omitted category are provided in each figure). Further, the findings in Panel (C) suggest that the principals in highest-poverty schools were four-times more likely to report that they do not offer 8th grade algebra at all compared to lowest-poverty schools. All these results are virtually unchanged after controlling for state fixed effects, school

[9] Our indicators of algebra availability/access in 8th grade are derived from the following survey question: "Indicate if your school offers any of the following opportunities this school year (2023-2024), and which students can participate: Algebra in 8th Grade". As such, we assume that "algebra content" is only offered in courses labeled as "Algebra" in 8th grade. It is important to note that this could be problematic if the courses offered instead of algebra (in settings where 8th grade algebra is not offered) are equally (or more) rigorous.

urbanicity and size, and school racial/ethnic composition. Panels (B) and (D) repeat the same analysis using school racial/ethnic composition (Appendix Table 1B presents the numbers) and reveal no significant differences in the availability of 8th grade algebra based on school racial/ethnic composition. Appendix Figure 1 repeats the same analysis looking at the availability of algebra in 9th grade and reveals no significant differences based on school poverty, yet some small, yet statistically significant, differences based on Black/Hispanic share: schools with highest shares of Black/Hispanic students are less likely to offer algebra in 9th grade unconditionally or offer algebra at all.

Overall, these findings suggest two mechanisms by which students in high poverty schools have less access to 8th grade algebra: first, it is less likely to be offered by their school at all, and second, if it is offered, it is less likely that the opportunity is open to any student who wants to participate. To further explore what determines access to algebra when it is not offered universally, we then examine which data sources schools use to determine placement in advanced math courses. In particular, principals who indicated that only certain students are able to participate in algebra were then asked which data sources they use to determine which students can participate, the results of which are shown in Figure 2 (Appendix Tables 2A and 2B present the numbers). We find few differences by school poverty or racial/ethnic composition quartiles across all models in the use of standardized assessment data, principal’s own knowledge of the student, or counselor referral for placement decisions.

Panel (E) in Figure 2 shows that highest-poverty schools are 8 percentage points less likely to use parent requests as a factor, with no differences by racial/ethnic composition in Panel (F). Panel (H) shows that schools with highest shares of Black or Hispanic students are 10 percentage points less likely to use teacher referral as a factor, and highest-poverty schools are 7 percentage points less likely (Panel G). This suggests that parents and teachers in lower poverty schools and teachers in lowest-Black/Hispanic share schools are either more likely to advocate for students, and/or their advocacy is more likely to be taken into consideration for math course placement. Higher use of these more subjective types of data may have consequences for access to math courses. On the one hand, it could create greater inequities in access depending on which students have adults advocating for them (e.g., LiCalsi, Ozek, and Figlio, 2019; Card and Guiliano, 2015).[10] On the other hand, it could grant access to some students with great potential who would not have accessed the courses based purely on more objective measures such as test scores or grades (Rothstein, 2004).[11]

Interestingly, we also find that highest-poverty and highest-Black/Hispanic share schools (schools in the highest quartile based on Black/Hispanic student share) are less likely to use prior course grades for course placement (by 9 and 10 percentage points, respectively). Panels (I) and (J) demonstrate how some of the differences we see by poverty are explained by racial composition, and vice versa, as the results become statistically insignificant once these controls are added in the final models. But the pattern typically holds that prior course grades are not used as frequently in these schools as compared to schools with lower rates of poverty and Black or Hispanic students.

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[10] For example, there is evidence in early grade retention context suggesting that parents from more advantaged socioeconomic backgrounds are more likely to advocate for their children and avoid retention using subjective exemption criteria compared to lower-SES parents of students with similar achievement levels (LiCalsi, Ozek, and Figlio, 2019).

[11] In fact, choosing the right measures to use in advanced course placement decisions is a challenge schools and school districts constantly face (e.g., Gao and Adan, 2016).

Do schools engage in achievement level grouping within and/or across math courses and how does this vary across school settings? Figure 3 addresses this question (Appendix 3A and 3B provide the numbers) and asks whether students are grouped by achievement level for math in middle school, and if so, whether they are grouped within courses (e.g., by forming small groups within the same class) or into courses. Panels (E) shows that principals in highest-poverty schools were nearly three-times more likely to report that they do not engage in achievement grouping within or into math courses. For schools that do group by achievement, grouping within courses is more common in highest-poverty schools: principals in these schools were nearly twice as likely to report that they group students by achievement within math courses (relative to principals in the lowest-poverty schools). In contrast, grouping into courses is less common in highest-poverty and highest-Black/Hispanic share schools. Lack of achievement grouping into courses may signal less variety in course offerings, or less differentiation or access to advanced pathways for students with the potential to succeed in more advanced pathways.

To further explore this, in Figure 4 (and in Appendix Tables 4A and 4B), we look at which math courses, besides (or instead of) algebra, are offered in 7^{th} and 8^{th} grades in different middle school contexts. Panel (A) shows that highest-poverty middle schools are 12 percentage points more likely to offer general math to 7^{th} and 8^{th} graders, with no differences seen by racial composition, except when controlling for school poverty (Panel B). Panels (C) through (F) show that, in some specifications, highest-poverty and highest-Black/Hispanic share schools are less likely to offer pre-algebra or Algebra II in 7^{th} and 8^{th} grade. Panel (G) shows that highest-poverty schools are less likely to offer geometry, and those differences are largely unchanged by the addition of covariates. Panel (H) shows that schools with higher shares of Black or Hispanic students are also less likely to offer geometry, but that the difference is somewhat explained by school poverty. General math is likely a less rigorous course than pre-algebra, Algebra II, or geometry, suggesting that highest-poverty schools and schools with greater shares of Black or Hispanic students are less likely to offer more advanced middle school mathematics courses, including courses that lay the groundwork for preparation for college-level math courses in high school.

A related question is whether highest-poverty high schools are less likely to offer college credit-bearing math courses, and—when such courses are offered—whether all students have access to them. These are important questions because one of the main objectives of students taking algebra earlier is that it allows students to take college credit-bearing math courses by the end of high school, which has been shown to be beneficial for postsecondary outcomes. Yet if these advanced high school courses are not available for students in disadvantaged school settings, offering more access to algebra in 8th grade will not have the desired effect of closing the socioeconomic and racial/ethnic gaps in enrollment in (and completion of) college credit-bearing math courses in high school.

Appendix Figure 2 examines the socioeconomic and racial/ethnic discrepancies in the likelihood that the high school offers AP Calculus and AP Statistics, two math courses students who complete Algebra I in 8th grade often take by the end of 12th grade. The results suggest large socioeconomic differences in whether these courses are offered: For example, principals in lowest-poverty high schools were more than twice as likely to report that their school offers AP Calculus and 50 percent more likely to report that their school offers AP Statistics compared to principals in highest-poverty schools. Similar findings emerge when we examine discrepancies by school racial/ethnic composition in AP Statistics.

Appendix Figure 3 examines achievement grouping within and into math courses in high school. The results suggest that, similar to middle schools, highest-poverty high schools are less likely to engage in achievement grouping across math courses, which could imply that advanced math courses, if offered, may be more accessible for students in highest-poverty school settings compared to lowest-poverty school settings. That said, it is important to note that these differences in achievement grouping across math courses could also be driven by the fact that highest-poverty schools are less likely to offer advanced math courses in high school. As such, achievement grouping across math courses may be less necessary in those settings given that there is less differentiation in content across math courses.

Teachers and Classroom Experiences in Math Courses

Our analysis thus far has focused on the availability of (and access to) advanced math courses in middle and high school, with emphasis on 8^{th} (and 9^{th}) grade algebra. Another important question in this context to better understand differences in algebra completion rates is the discrepancies in educational resources and classroom experiences of students in math courses across school settings. After all, even with universal access to 8^{th} grade algebra, socioeconomic and racial/ethnic gaps in algebra completion rates may emerge if highest-poverty schools face challenges staffing these courses with qualified teachers or if the instruction in these classrooms fails to meet the educational needs of students.

To address this question, we use data from both the principal and teacher surveys to highlight differences in resources within math courses by school poverty and racial/ethnic composition. To explore these types of resources in math courses across these contexts, the specific data we use from the survey includes the following: (1) principal-reported average weekly minutes of instructional time for Algebra I; (2) the types of teacher preparation programs that math teachers completed, including whether teachers completed student-teaching as part of their preparation program; (3) the types of credentials and licensures that math teachers hold; and (4) the proportion of time math teachers spend on various instructional activities.

Figure 5 shows the average weekly minutes of algebra instruction by poverty and racial/ethnic composition (estimates are provided in Appendix Tables 6A and 6B). Principals report about four-and-a-half hours of algebra instruction weekly, and the averages do not significantly differ by school context. This suggests that course scheduling practices and/or policies related to instructional time in algebra do not differ much for highest-poverty schools or highest- Black/Hispanic share schools. That said, it is important to note that this finding is conditional on a school offering algebra in 8th grade, which is likely a selective sample given the documented discrepancies in 8th grade algebra offering across school settings documented earlier.

We also find mostly comparable rates of 8th and 9th grade math teachers with both multi-subject credentials and single-subject mathematics credentials across school contexts, as shown in Figure 6 and Appendix Tables 7A and 7B. We also find that 8th and 9th grade math teachers in the highest-poverty schools are 12 percentage points (roughly equivalent to 20 percent of the mean for lowest-poverty schools) less likely to hold a single-subject credential in math (and hence are less likely to be "math specialist" teachers) compared to math teachers in lowest-poverty schools, though this difference is only marginally significant (p-value = 0.088).[12]

In Figure 7, we show variation in types of teacher preparation programs by school context (Appendix Tables 8A and 8B provide the estimates). In Panel (C), we see that 8th and 9th grade math teachers in highest-poverty schools are significantly less likely to have completed a graduate program for their teacher preparation (the difference between highest-poverty and lowest-poverty schools is roughly equal to 15 percentage points, or one-third of the mean for lowest-poverty schools), but there are no differences by student racial composition (Panel D). In Panel (G), we see that teachers in highest-poverty schools are significantly more likely to hold an alternative certification, and this is also true for teachers in highest-Black/Hispanic share schools (Panel H). In particular, 8th and 9th grade math teachers in highest-poverty schools were nearly three times more likely to report that they completed an alternative certification program compared to math teachers who work in schools that fall into the lowest-poverty quartile while math teachers in schools that serve the highest share of Black/Hispanic students were four times more likely to have completed an alternative certification program compared to math teachers in schools that serve lowest shares of Black and Hispanic students.

In Panels (I) and (J), we also see that 8th and 9th grade math teachers in highest-poverty and highest-Black/Hispanic share schools are less likely to have completed student teaching as part of their preparation, though these differences disappear when we include state fixed effects,

[12] Single subject certified teachers typically take more content courses in that subject (e.g., math) compared to multiple subject credentialed teachers. Further, single subject certified teachers are also required to pass a specific subject matter exam in most states.

school size, and urbanicity. Figure 8 (along with Appendix Tables 9A and 9B) shows that, in some models, teachers in schools with higher shares of Black or Hispanic students are significantly less likely to have fulfilled all of the licensure requirements to teach math. Taken together, these trends suggest that 8th and 9th grade math teachers in lower poverty schools and lowest-Black/Hispanic share schools may have more advanced and/or more complete training than teachers of the same grades in highest-poverty and highest-Black/Hispanic share schools, and raise questions about whether high-poverty schools can staff advanced math courses with qualified teachers if they increase access to algebra in 8th grade.

We then examine how teachers spend their time in math courses and how this varies across school settings. In particular, Figure 9 shows the proportion of teachers spending more than half of their instructional time on various classroom activities (Appendix Tables 10A and 10B present the numbers). In Panel (A), we see that significantly more teachers in high poverty schools spend more than half of their time addressing mathematics topics below their grade level, and this difference is unchanged by the addition of covariates: teachers in highest-poverty schools were 14 percentage points (roughly equivalent to 70 percent of the mean for the teachers in lowest-poverty schools) more likely to report that they spend more than half of their instruction time addressing topics below grade level. In Panels (C), (E), and (G), we see that these teachers also spend more time providing verbal instruction, doing a test or a quiz, and maintaining order/disciplining students. With the exception of tests/quizzes, these differences do not hold for schools with higher shares of Black or Hispanic students. These results suggest that in highest-poverty schools, students have less opportunity to access grade-level content, more instructional time is spent on non-interactive activities (i.e., verbal instruction and tests/quizzes), and that their teachers lose more instructional time to disciplinary issues.

Concluding Remarks

Algebra plays an outsized role in middle and high school math curriculum in the United States with students taking and completing algebra earlier being more likely to take college credit-bearing math courses in high school, which in turn could be beneficial for postsecondary outcomes. Yet, significant disparities exist in access to (and completion of) 8th grade algebra along socioeconomic and racial/ethnic lines. In this study, we provide a national look at the availability of (and access to) 8th and 9th grade algebra in different school settings, which may contribute to observed gaps in algebra enrollment, and the discrepancies in educational resources and classroom activities for mathematics along school poverty and racial/ethnic composition. There are several important takeaways.

First, the findings suggest significant disparities in algebra availability/access between lowest- and highest-poverty schools, with highest-poverty schools being significantly less likely to offer 8th grade algebra or offer it for all students regardless of their prior test scores or course-taking. We find similar discrepancies at the high school level for advanced math courses. Second, we show significant differences between the highest-poverty and lowest-poverty schools in terms of the criteria used to place students in advanced math courses in 8th and 9th grades, which may affect the access of students from disadvantaged backgrounds to advanced math courses even when they are offered. Third, the findings suggest that teachers in highest-poverty schools are significantly more likely to receive alternative credentials, less likely to have completed student-teaching during their preparation program, and less likely to have completed their state's licensure requirements for math compared to teachers in lowest-poverty schools. Fourth, we find significant differences in how 8^{th} and 9^{th} grade math teachers spend their instruction time between school settings, with teachers in highest-poverty schools being more likely to report that they spend more than half of their instruction time addressing math topics below grade level or addressing disciplinary issues. We observe similar, yet weaker, patterns when we examine discrepancies along school racial/ethnic composition.

These findings imply that offering 8^{th} grade algebra in high-poverty school settings (or making it available to more or all students) could help close socioeconomic gaps in algebra enrollment in 8^{th} grade. That said, 8th grade algebra is only part of the larger systemic inequities that disadvantage low-income students and Black and Hispanic students. Focusing on the provision of 8^{th} grade algebra alone will likely not remedy the opportunity gaps in access to (and completion of) college credit-bearing math courses in high school along socioeconomic lines since our findings suggest that highest-poverty high schools are also significantly less likely to offer these courses. Further, our findings suggest that increasing the provision of algebra in 8^{th} grade may present three challenges: (1) staffing these courses with qualified teachers; (2) providing strong supports for students who struggle with algebra; and, relatedly, (3) making algebra placement decisions that minimize failure and maximize success for the greatest number of students. Additionally, preparation for 8^{th} grade algebra occurs prior to 8^{th} grade, and therefore, the inequities seen in 8^{th} and 9^{th} grade math (and beyond) are likely also reflective of discrepancies in the math learning experiences students have prior to 8^{th} grade.

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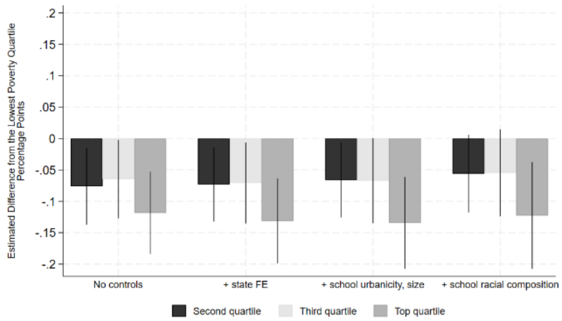
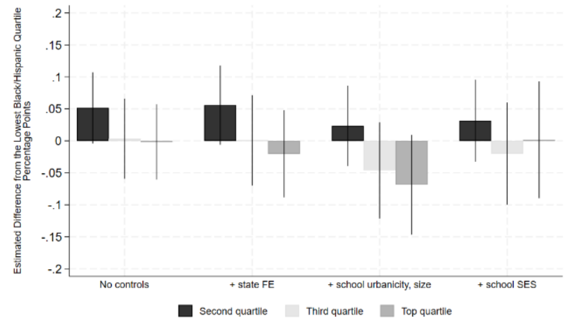
Figure 1. 8th Grade Algebra: Availability and Access, by School Poverty and Racial/Ethnic Composition

School offers algebra in 8th grade; any student can participate

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.48)

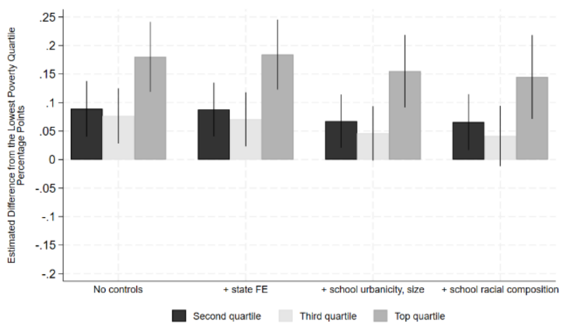


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.36)

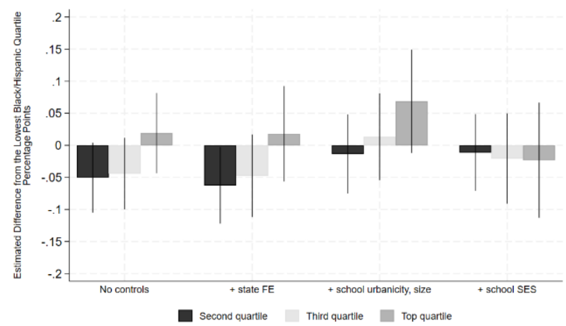


School does not offer algebra in 8th grade

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.06)



(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.17)

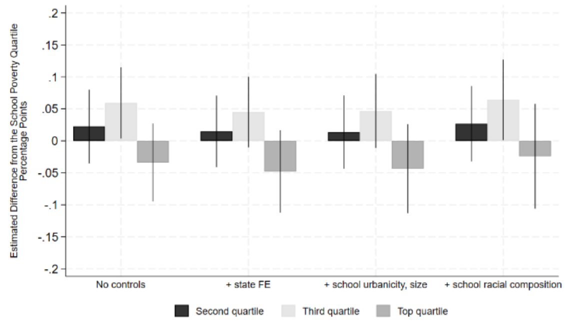


Notes: The outcomes of interest come from principal responses to the survey question: "Indicate if your school offers any of the following opportunities this school year (2023-2024), and which students can participate: Algebra in 8th Grade". We restrict the analysis to principals who indicated that their school served 8th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

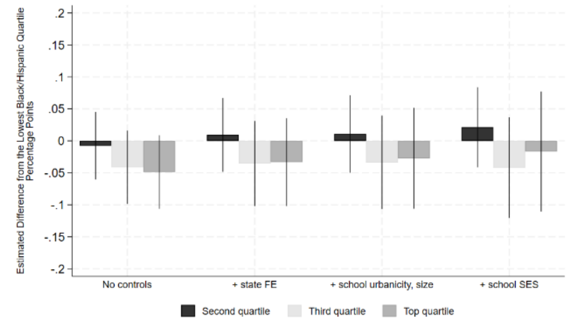
Figure 2. Factors Considered When Deciding Which Students Can Participate in Advanced Math Courses, by School Poverty and Racial/Ethnic Composition

Standardized assessment data is a factor

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.66)

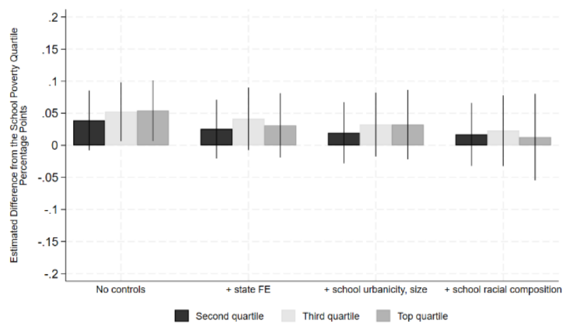


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.73)

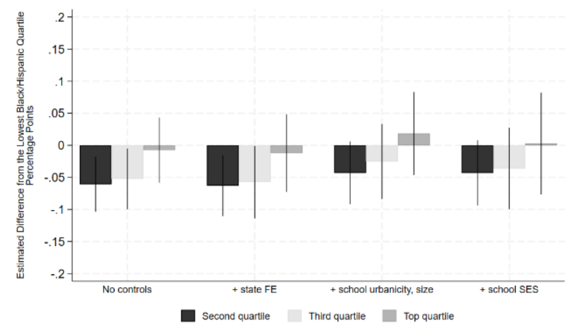


Principals' knowledge of student is a factor

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.28)

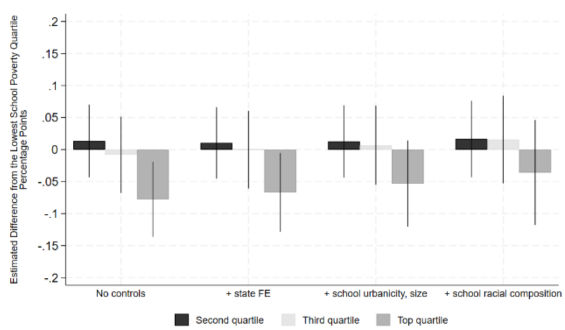


(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.40)

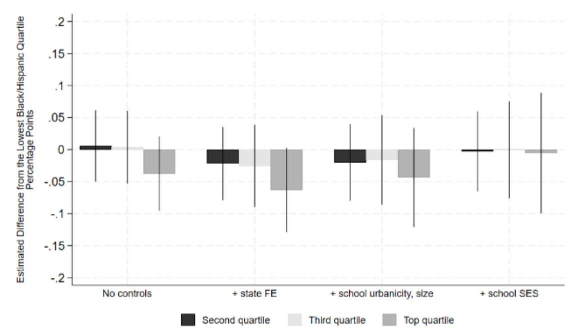


Parent request is a factor

(E) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.49)



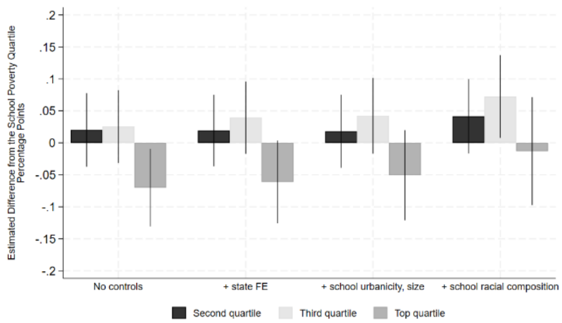
(F) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.53)



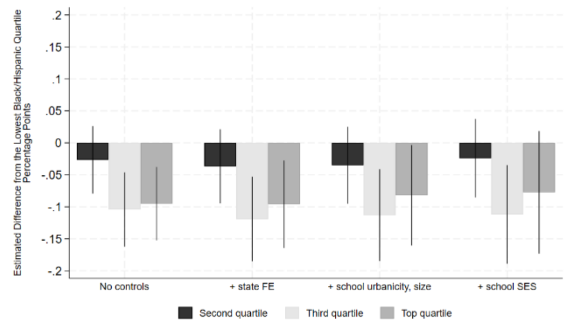
(Figure 2 continued)

Teacher referral is a factor

(G) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.67)

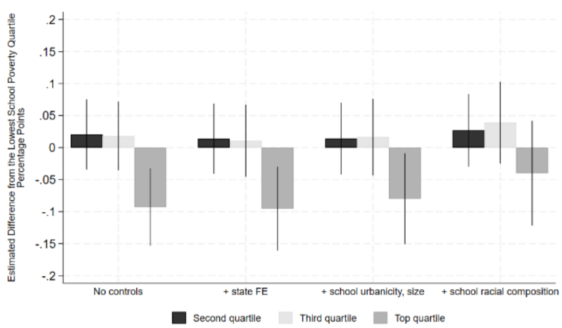


(H) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.75)

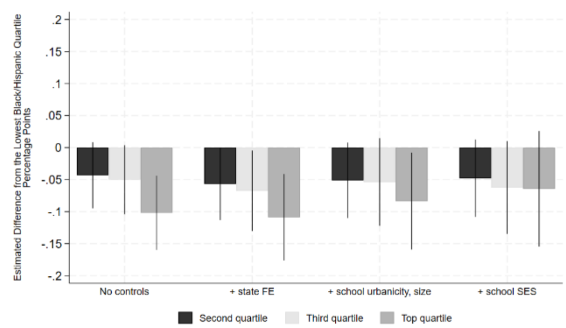


Prior course grade is a factor

(I) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.71)



(J) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.78)

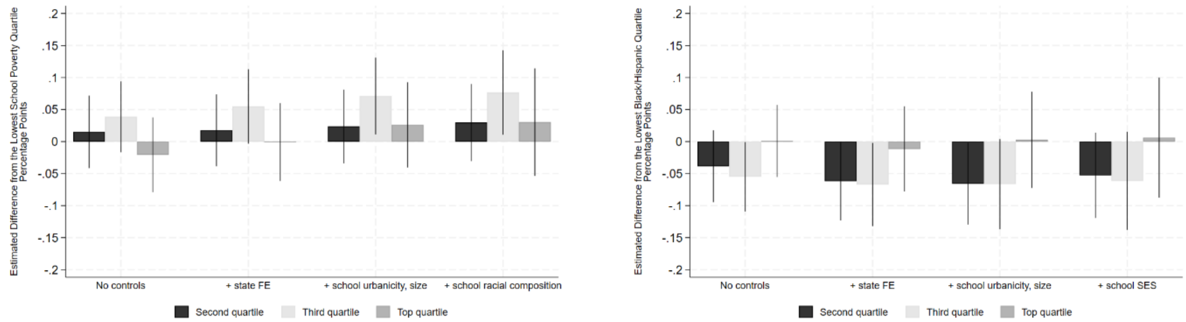


Counselor referral is a factor

(K) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.41)

(L) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.48)

(Figure 2 continued)

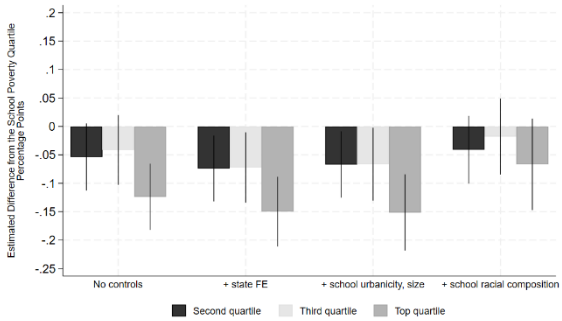


Notes: The outcomes of interest come from principal responses to the survey question: "You indicated that only certain students can participate in some of the opportunities listed in the previous question. Do you use each of the following data sources when deciding which students can participate?". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

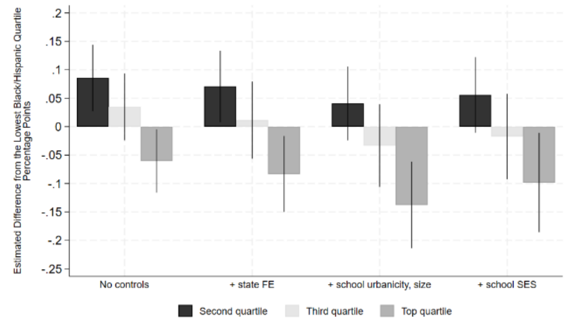
Figure 3. Achievement Grouping in Math Courses: Grades 6-8, by School Poverty and Racial/Ethnic Composition

Achievement grouping across math courses

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.33)

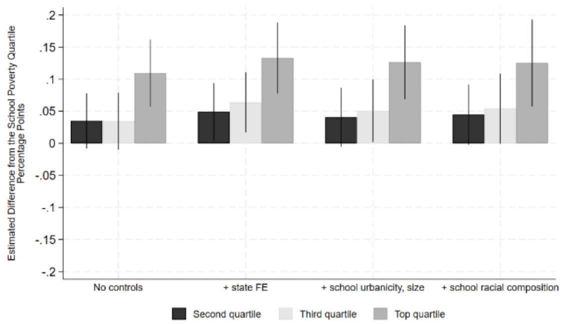


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.27)

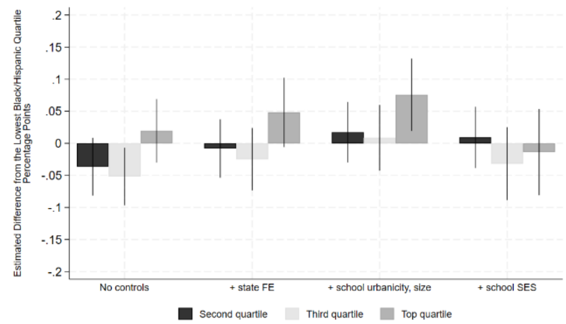


Achievement grouping within math courses

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.13)

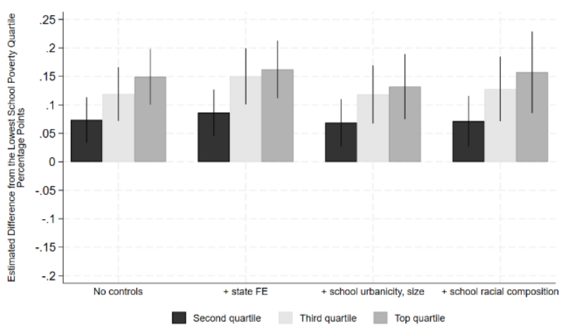


(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.18)

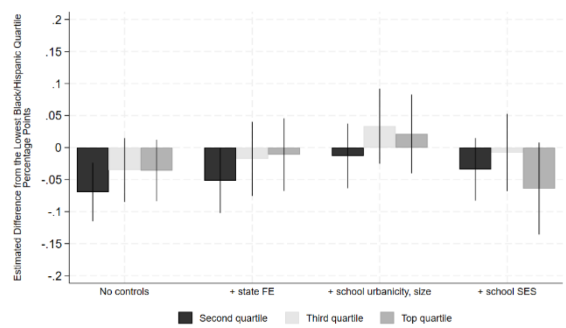


No achievement grouping

(E) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.09)



(F) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.21)



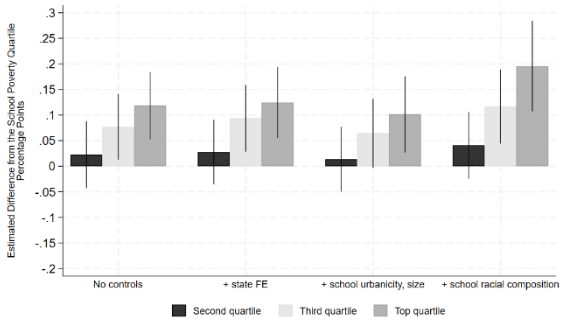
Notes: The outcomes of interest come from principal responses to the survey question: “Some schools organize mathematics instruction differently for students with different achievement levels. What is your school’s policy about

how students are grouped in the following grade bands? Grades 6-8”. We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

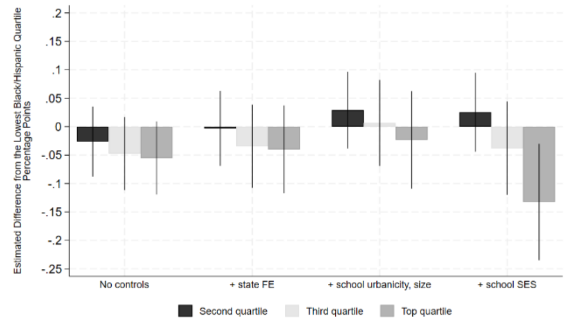
Figure 4. Math Courses Offered in Grades 7 and 8 Other than Algebra I, by School Poverty and Racial/Ethnic Composition

General math

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.56)

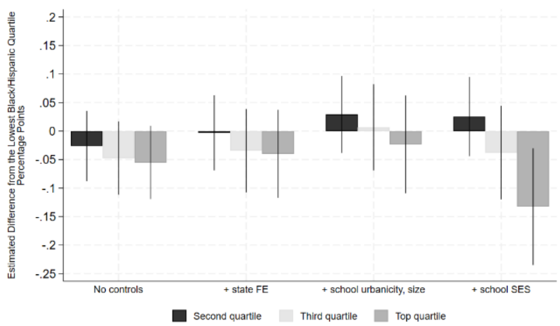


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.64)

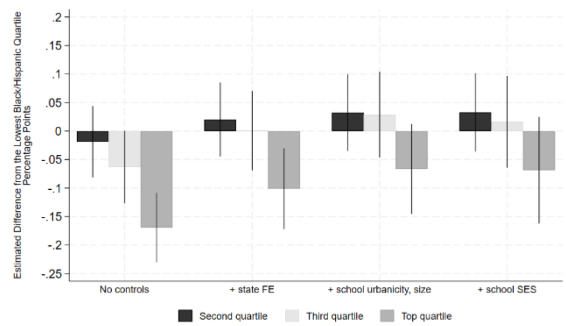


Pre-algebra

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.41)

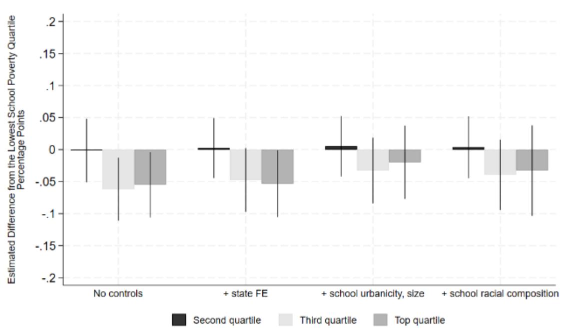


(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.44)

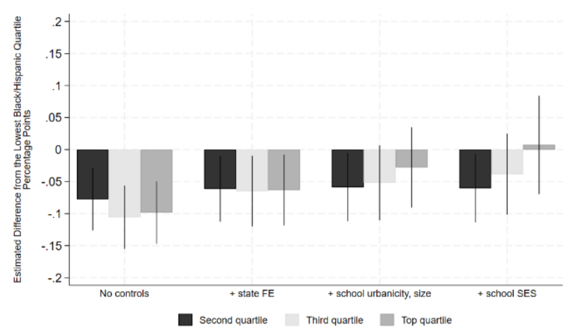


Algebra II

(E) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.33)



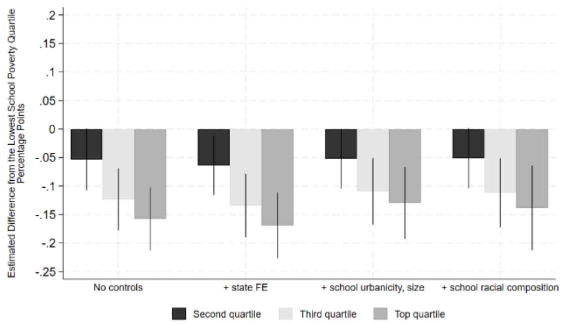
(F) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.34)



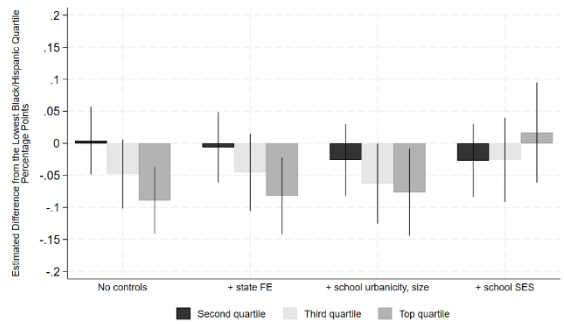
(Figure 4 continued)

Geometry

(G) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.46)



(H) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.39)

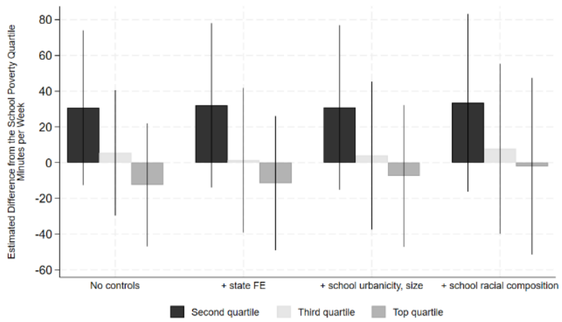


Notes: The outcomes of interest come from principal responses to the survey question: "This school year, which of the following mathematics and computer science courses are offered on site at your school for students in any grades 7 through 8? SELECT ALL THAT APPLY". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

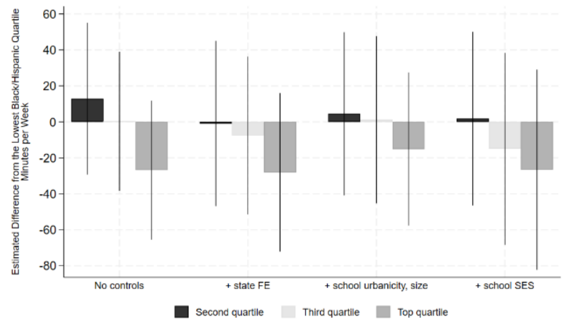
Figure 5. Instruction Time in Algebra, by School Poverty and Racial/Ethnic Composition

Minutes per week

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 269)



(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 277)

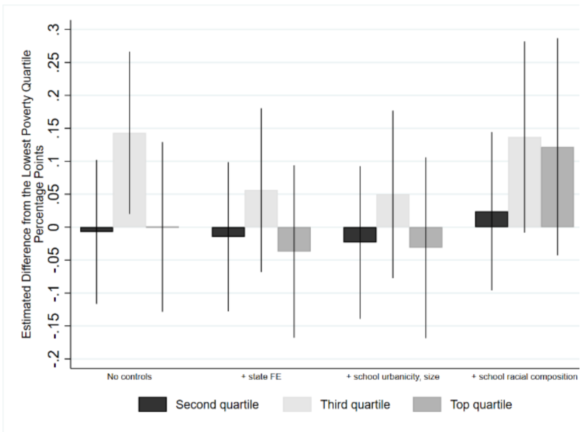


Notes: The outcomes of interest come from principal responses to the survey question: "Average weekly instructional minutes for Algebra I.". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

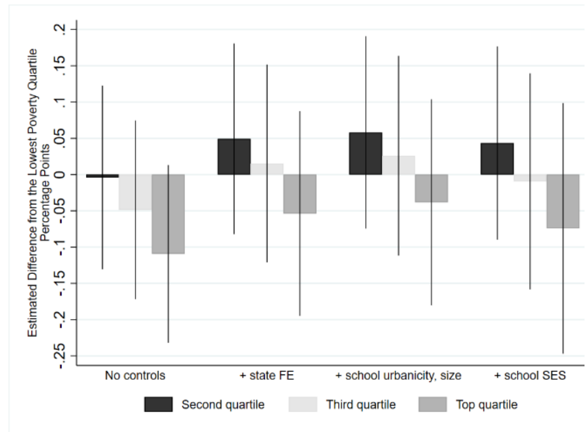
Figure 6. 8th and 9th Grade Math Teachers: Credential Subject Area and Specialization, by School Poverty and Racial/Ethnic Composition

Multi-subject credential

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.32)

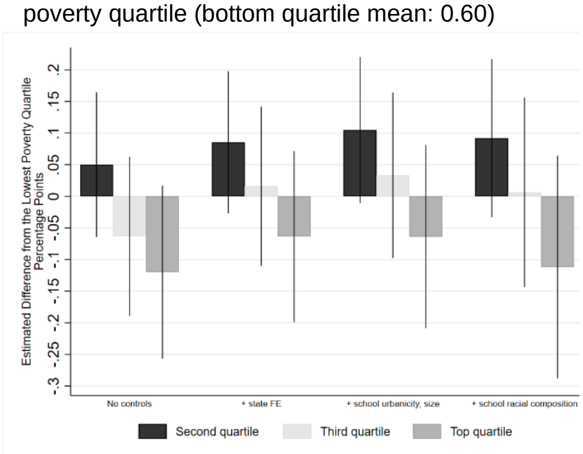


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.40)

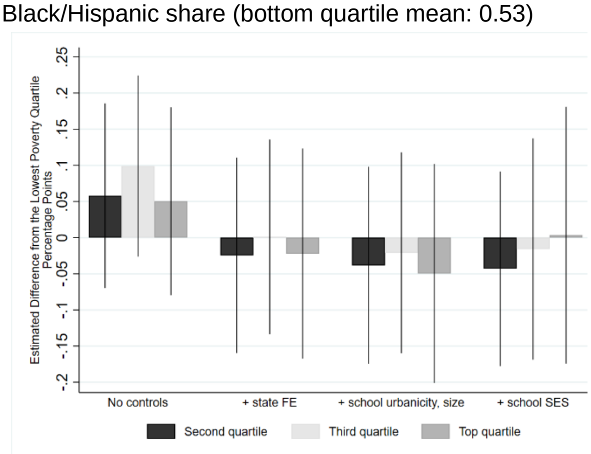


Single-subject mathematics

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.60)



(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.53)

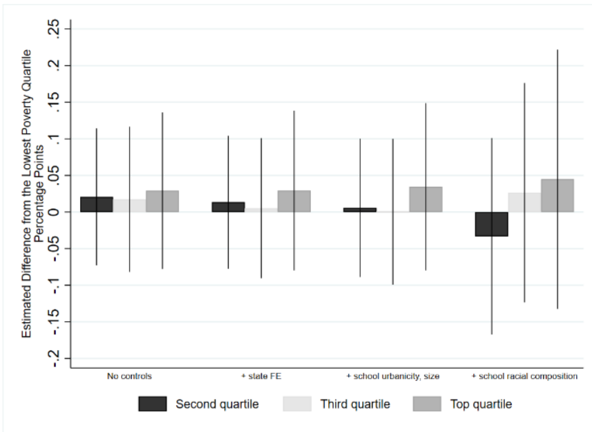


Notes: The outcomes of interest come from teacher responses to the survey question: "In what subject area(s), specialization(s), or grade(s) do you hold a teacher credential? SELECT ALL THAT APPLY". We restrict the analysis to 8^{th} and 9^{th} grade math teachers. In the left panel, each bar represents the estimated differences between the teacher responses in schools that fall into the lowest poverty quartile and the responses of teachers in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

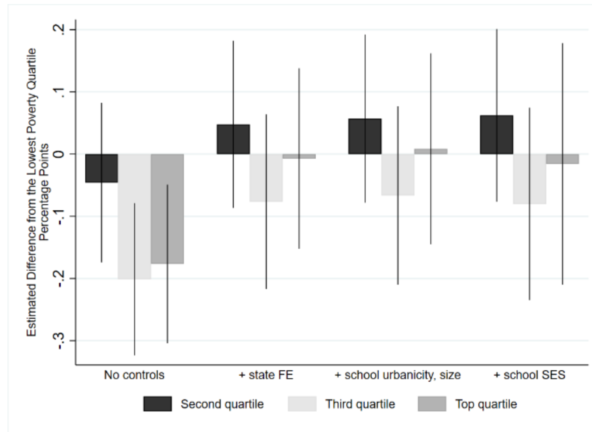
Figure 7. 8th and 9th Grade Math Teachers: Teacher Preparation Program, by School Poverty and Racial/Ethnic Composition

Undergraduate program only

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.46)

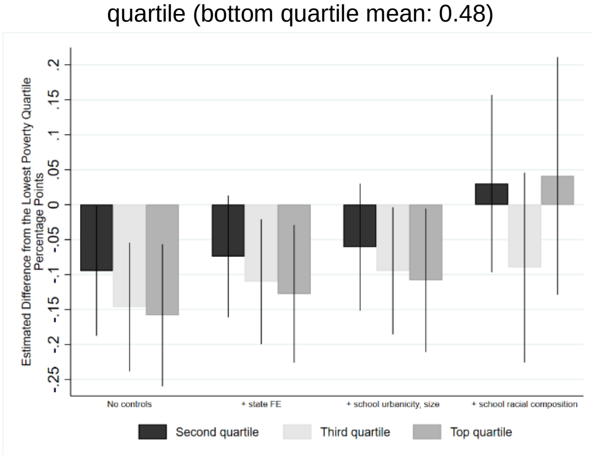


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.51)

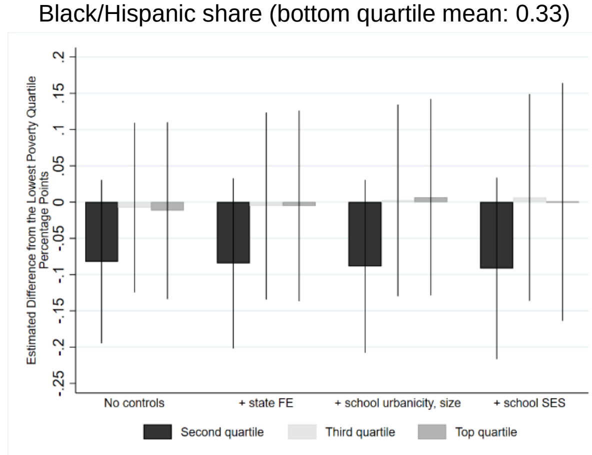


Graduate program only

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.48)



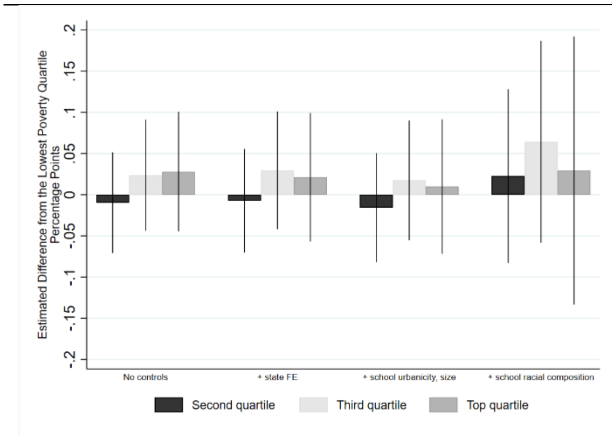
(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.33)

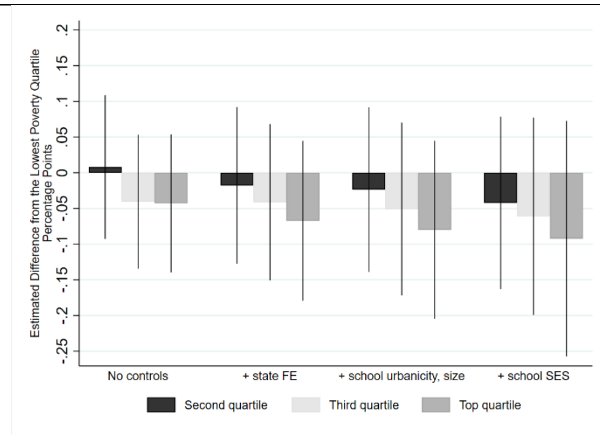


Program that included both undergraduate and post-baccalaureate components

(E) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.15)

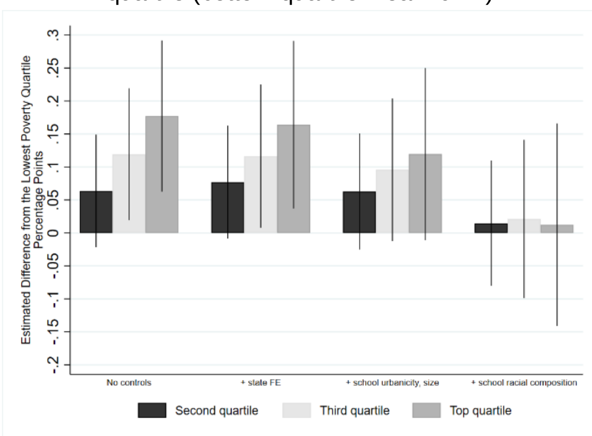
(F) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.21)

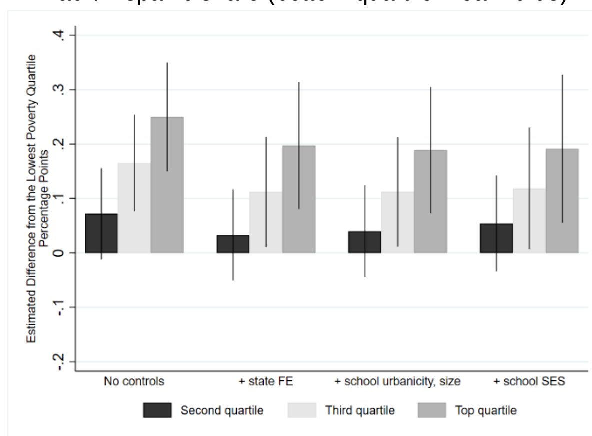




Alternative certification program

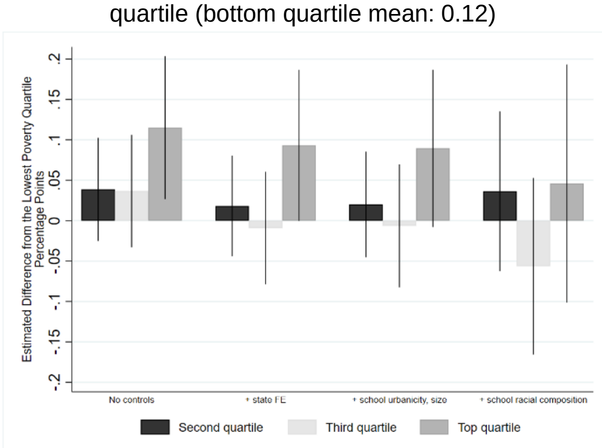
(G) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.12)	(H) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.08)

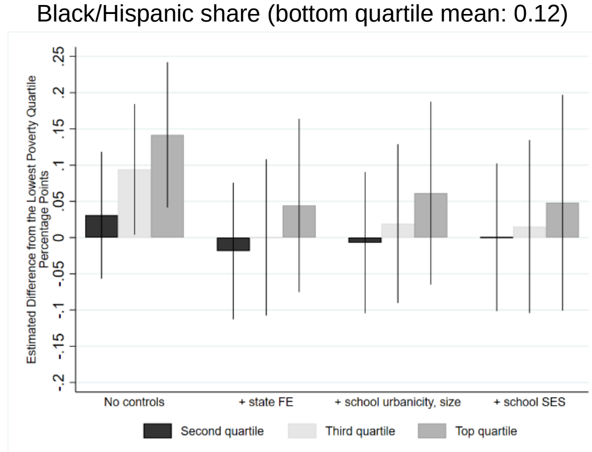




Did not student teach as part of teacher preparation program

(I) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.12)	(J) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.12)





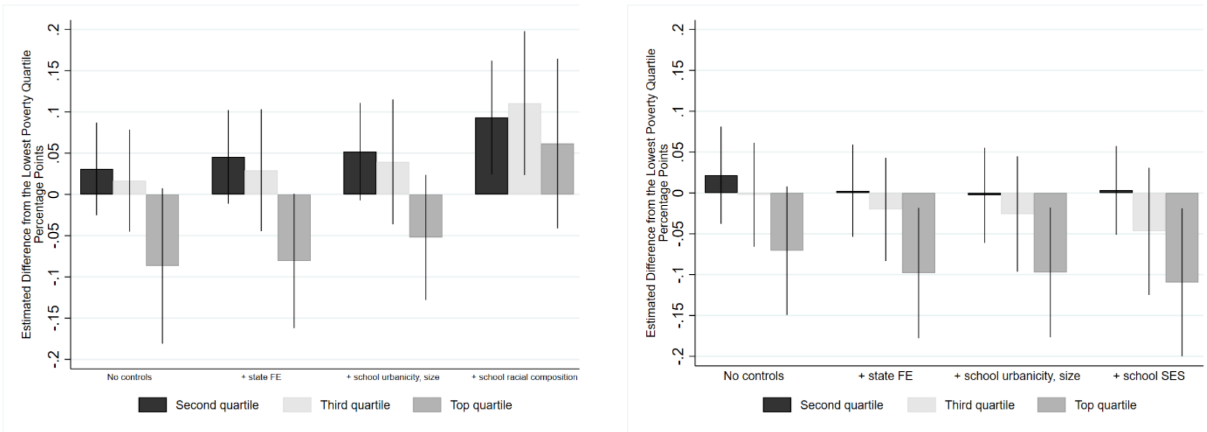
Notes: The outcomes of interest come from teacher responses to the survey questions: “How would you describe the teacher preparation program you completed?” and “As part of your teacher preparation, how long did you student teach?”. We restrict the analysis to 8th and 9th grade math teachers. In the left panel, each bar represents the estimated differences between the teacher responses in schools that fall into the lowest poverty quartile and the responses of teachers in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

Figure 8. 8th and 9th Grade Math Teachers: Fulfilled Teacher Licensure Requirements, by School Poverty and Racial/Ethnic Composition

Completed all the teacher licensure requirements for math

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.93)

(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.94)



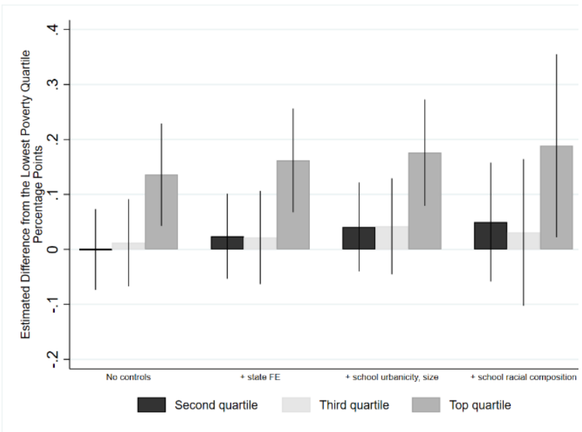
Notes: The outcomes of interest come from teacher responses to the survey question: "Please indicate which of the following best represents when or if you've fulfilled all the teacher licensure requirements in your state in mathematics for the grade(s) you teach.". We restrict the analysis to 8th and 9th grade math teachers. In the left panel, each bar represents the estimated differences between the teacher responses in schools that fall into the lowest poverty quartile and the responses of teachers in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

Figure 9. Classroom Activities for Teachers in 8th and 9th Grade Math Courses, by School Poverty and Racial/Ethnic Composition

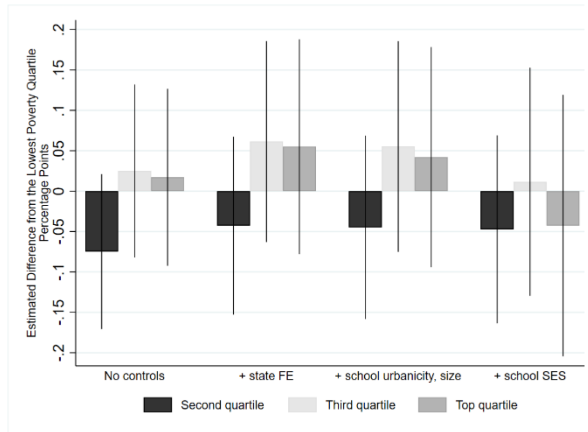
In a typical week, spend more than 50% of time in…

…addressing mathematics topics below their grade level

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.21)

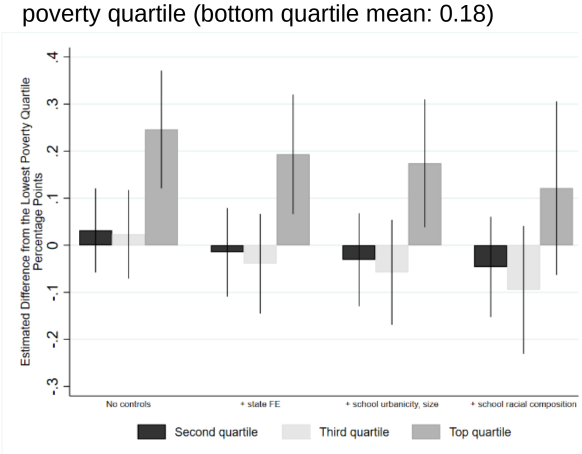


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.21)

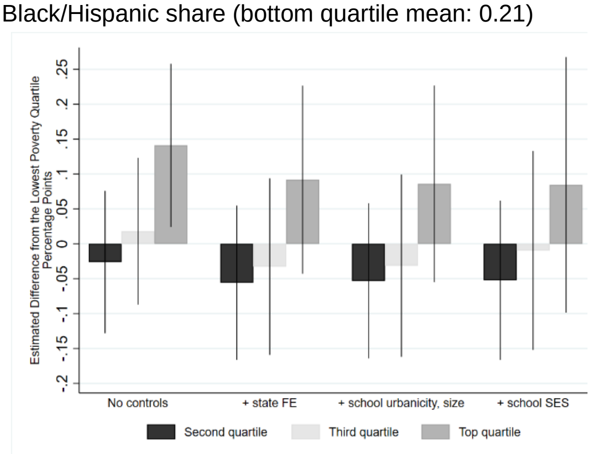


…providing mathematics instruction verbally (excluding classroom discussion)

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.18)



(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.21)

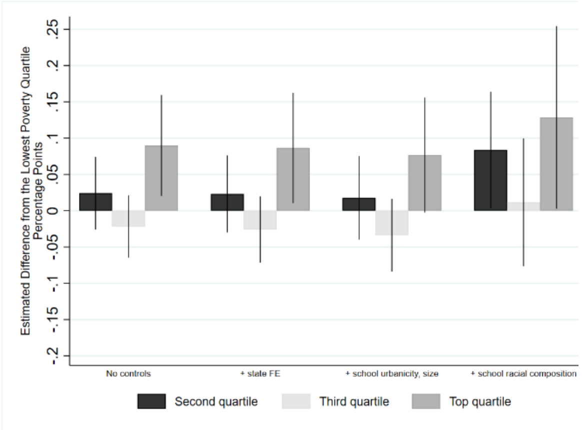


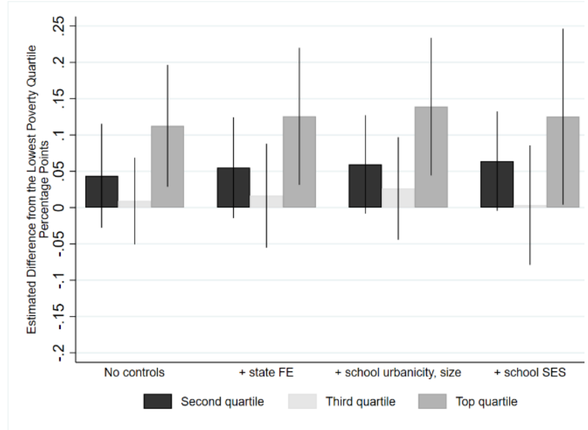
…taking a test or quiz

(E) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.08)

(F) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.06)

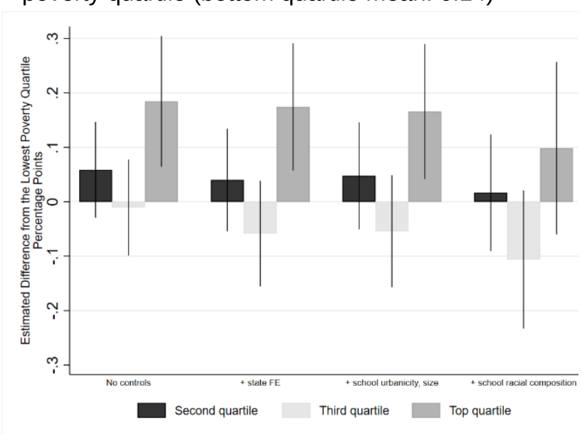
In a typical week, spend more than 50% of time in…



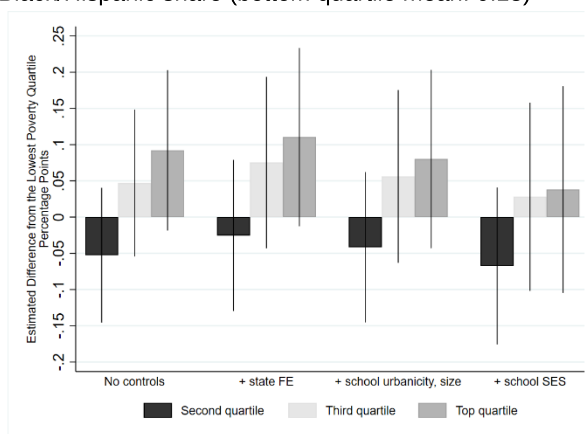


…maintaining order/disciplining students

(G) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.14)



(H) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.18)



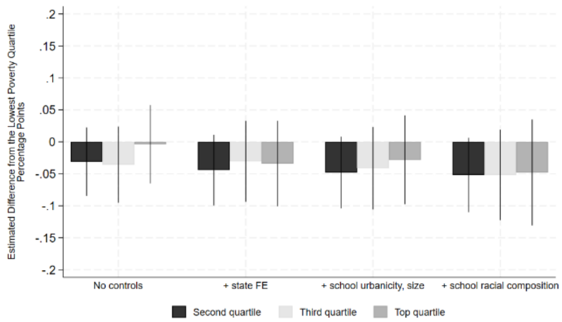
Notes: The outcomes of interest come from teacher responses to the survey question: "In a typical week, indicate about what percent of your time is spent doing the following activities with your typical math class. Percentages do not need to add up to 100 percent.". We restrict the analysis to 8^{th} and 9^{th} grade math teachers. In the left panel, each bar represents the estimated differences between the teacher responses in schools that fall into the lowest poverty quartile and the responses of teachers in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

Appendix A: Supplemental Figures

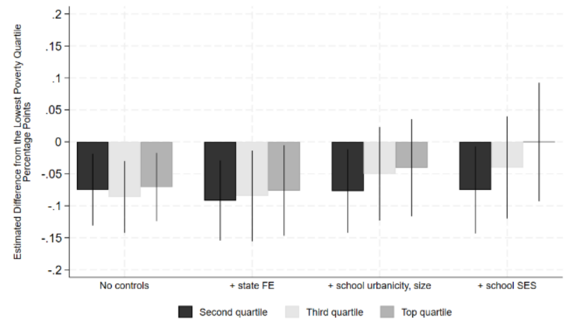
Appendix Figure 1. 9th Grade Algebra: Availability and Access, by School Poverty and Racial/Ethnic Composition

School offers algebra in 9th grade; any student can participate

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.07)

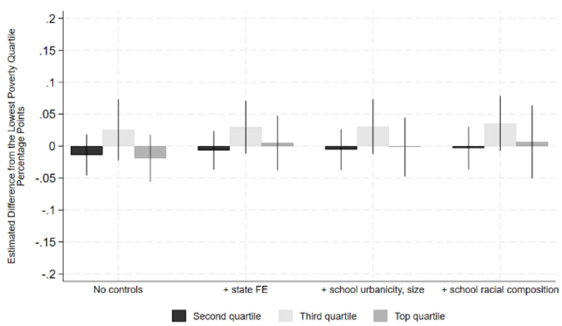


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.18)

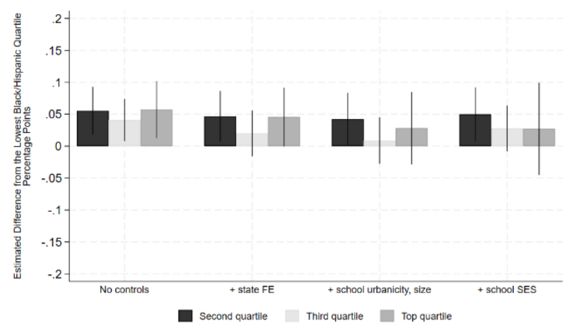


School does not offer algebra in 9th grade

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.02)



(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.01)

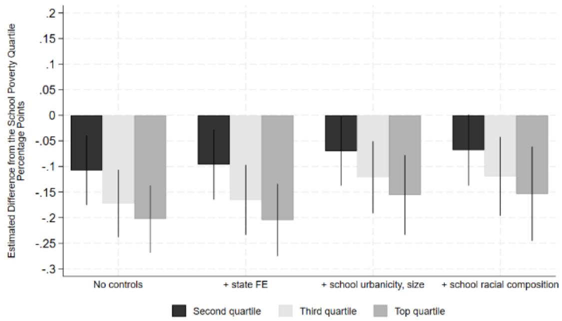


Notes: The outcomes of interest come from principal responses to the survey question: "Indicate if your school offers any of the following opportunities this school year, and which students can participate: Algebra in 9th Grade". We restrict the analysis to principals who indicated that their school served 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

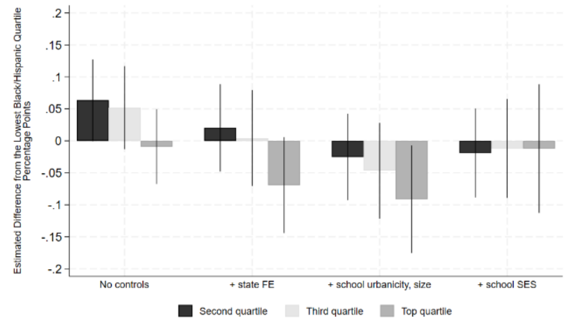
Appendix Figure 2. Math Courses Offered in Grades 9-12, by School Poverty and Racial/Ethnic Composition

AP Calculus

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.36)

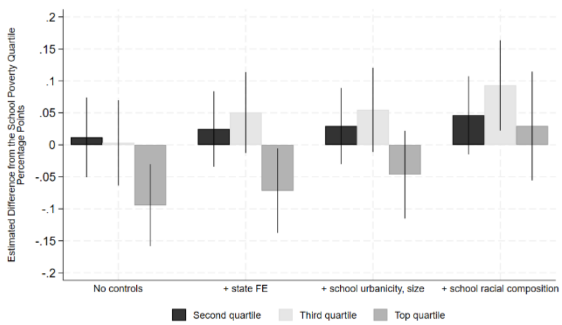


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.22)

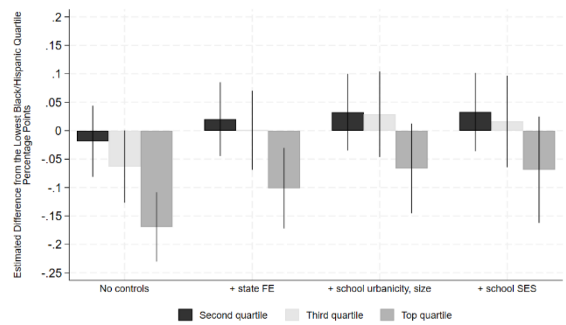


AP Statistics

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.29)



(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.14)

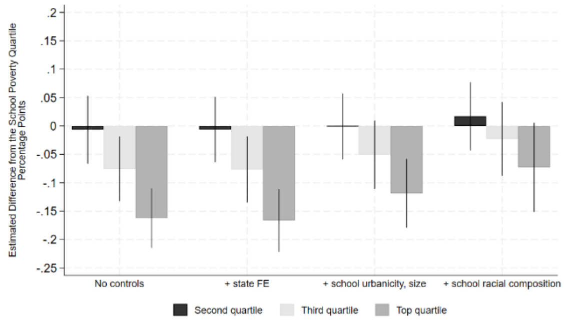


Notes: The outcomes of interest come from principal responses to the survey question: “This school year, which of the following mathematics and computer science courses are offered on site at your school for students in grades 9 through 12? SELECT ALL THAT APPLY”. We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

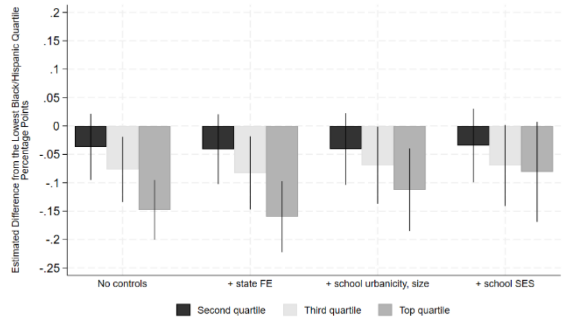
Appendix Figure 3. Achievement Grouping in Math Courses: Grades 9-12, by School Poverty and Racial/Ethnic Composition

Achievement grouping across math courses

(A) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.31)

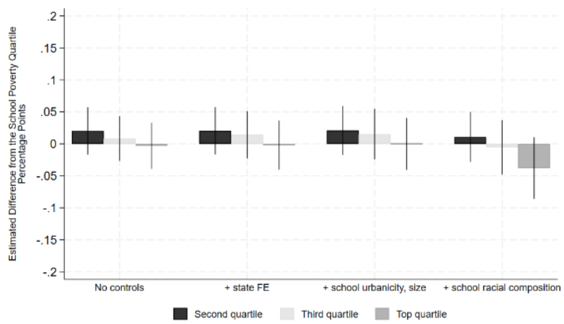


(B) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.35)

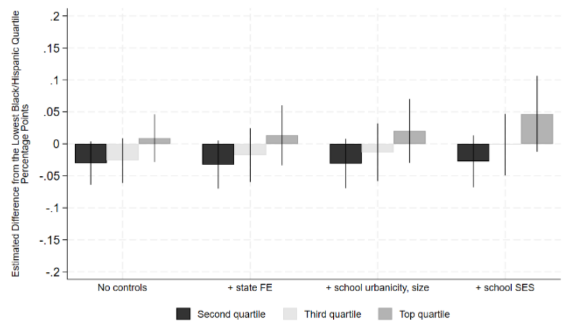


Achievement grouping within math courses

(C) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.10)

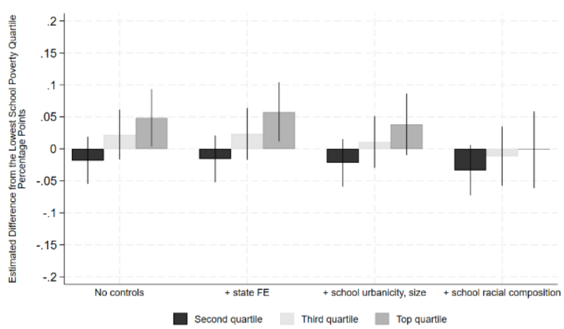


(D) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.11)

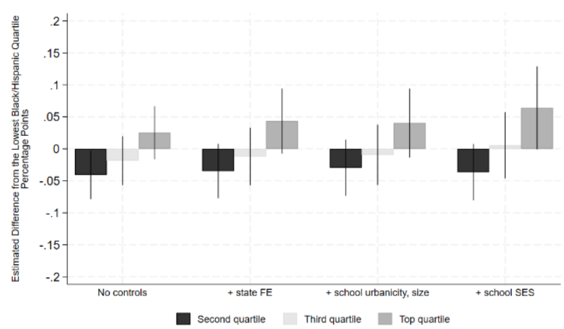


No achievement grouping

(E) Estimated difference from the lowest school poverty quartile (bottom quartile mean: 0.11)



(F) Estimated difference from the bottom quartile in Black/Hispanic share (bottom quartile mean: 0.12)



Notes: The outcomes of interest come from principal responses to the survey question: “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? Grades 9-12". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles; (1) using only survey-year fixed-effects as controls in the first group; (2) introducing state fixed-effects in the second group; (3) introducing school urbanicity and size in the third group; and (4) introducing measures of school racial/ethnic composition. The right panel repeats the same analysis using the share of Black and Hispanic students in the school (the fourth group introduces measures of school SES). Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

Appendix B: Supplemental Tables

Appendix Table 1A: Estimated Differences in 8th Grade Algebra Availability and Access, by School Poverty Quartile

	School offers algebra in 8th grade; any student can participate (Bottom quartile mean: 0.48)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	-0.076**	-0.073**	-0.066**	-0.056*
	(0.031)	(0.030)	(0.030)	(0.032)
Third	-0.065**	-0.071**	-0.067*	-0.055
	(0.032)	(0.033)	(0.035)	(0.035)
Top	-0.118***	-0.131***	-0.134***	-0.123***
	(0.033)	(0.035)	(0.037)	(0.043)
	School does not offer algebra in 8th grade (Bottom quartile mean: 0.06)			
Second	0.089***	0.088***	0.067***	0.066***
	(0.025)	(0.024)	(0.024)	(0.025)
Third	0.076***	0.071***	0.046*	0.041
	(0.025)	(0.024)	(0.024)	(0.027)
Top	0.180***	0.184***	0.155***	0.145***
	(0.031)	(0.031)	(0.032)	(0.038)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	2159	2159	2152	2152

Notes: The outcomes of interest come from principal responses to the survey question: "Indicate if your school offers any of the following opportunities this school year (2023-2024), and which students can participate: Algebra in 8th Grade". We restrict the analysis to principals who indicated that their school served 8th grade. Each estimate presents the difference in principal responses between the schools in the bottom school poverty quartile and the principals in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 1.

Appendix Table 1B: Estimated Differences in 8th Grade Algebra Availability and Access, by School Racial/Ethnic Composition

	School offers algebra in 8th grade; any student can participate (Bottom quartile mean: 0.36)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	0.052*	0.056*	0.023	0.031
	(0.028)	(0.032)	(0.032)	(0.033)
Third	0.003	0.001	-0.046	-0.020
	(0.032)	(0.036)	(0.038)	(0.041)
Top	-0.002	-0.020	-0.069*	0.002
	(0.030)	(0.035)	(0.040)	(0.046)
	School does not offer algebra in 8th grade (Bottom quartile mean: 0.17)			
Second	-0.050*	-0.063**	-0.014	-0.011
	(0.028)	(0.030)	(0.031)	(0.031)
Third	-0.044	-0.047	0.013	-0.021
	(0.029)	(0.033)	(0.035)	(0.036)
Top	0.019	0.018	0.068*	-0.023
	(0.032)	(0.038)	(0.041)	(0.046)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School poverty	No	No	No	Yes
N	2159	2159	2152	2152

Notes: The outcomes of interest come from principal responses to the survey question: "Indicate if your school offers any of the following opportunities this school year (2023-2024), and which students can participate: Algebra in 8th Grade". We restrict the analysis to principals who indicated that their school served 8th grade. Each estimate presents the difference in principal responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the principals in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 1.

Appendix Table 2A: Factors Considered When Deciding Which Students Can Participate in Advanced Math Courses, by School Poverty Quartile

	Standardized assessment data is a factor (Bottom quartile mean: 0.66)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	0.022	0.015	0.014	0.027
	(0.029)	(0.028)	(0.029)	(0.030)
Third	0.059**	0.045	0.047	0.064**
	(0.028)	(0.028)	(0.029)	(0.032)
Top	-0.034	-0.048	-0.044	-0.024
	(0.031)	(0.033)	(0.036)	(0.042)
	Principals' knowledge of student is a factor (Bottom quartile mean: 0.28)			
Second	0.039	0.025	0.020	0.017
	(0.024)	(0.023)	(0.024)	(0.025)
Third	0.052**	0.041*	0.032	0.023
	(0.023)	(0.025)	(0.025)	(0.028)
Top	0.054**	0.031	0.032	0.013
	(0.024)	(0.026)	(0.028)	(0.034)
	Parent request is a factor (Bottom quartile mean: 0.49)			
Second	0.013	0.010	0.013	0.017
	(0.029)	(0.028)	(0.029)	(0.030)
Third	-0.008	0.000	0.007	0.016
	(0.030)	(0.031)	(0.032)	(0.035)
Top	-0.078***	-0.067**	-0.053	-0.036
	(0.030)	(0.031)	(0.034)	(0.042)
	Teacher referral is a factor (Bottom quartile mean: 0.67)			
Second	0.020	0.019	0.018	0.041
	(0.029)	(0.028)	(0.029)	(0.030)
Third	0.025	0.039	0.042	0.072**
	(0.029)	(0.029)	(0.030)	(0.033)
Top	-0.070**	-0.061*	-0.051	-0.013
	(0.031)	(0.033)	(0.036)	(0.043)
	Prior course grade is a factor (Bottom quartile mean: 0.71)			
Second	0.020	0.014	0.014	0.027
	(0.028)	(0.028)	(0.029)	(0.029)
Third	0.018	0.011	0.016	0.039
	(0.027)	(0.029)	(0.031)	(0.033)
Top	-0.093***	-0.095***	-0.080**	-0.040
	(0.031)	(0.033)	(0.036)	(0.042)
	Counselor referral is a factor (Bottom quartile mean: 0.41)			
Second	0.015	0.018	0.024	0.030
	(0.029)	(0.029)	(0.029)	(0.031)
Third	0.039	0.055*	0.071**	0.077**
	(0.028)	(0.030)	(0.030)	(0.034)
Top	-0.021	-0.001	0.026	0.030
	(0.030)	(0.031)	(0.034)	(0.043)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes

School racial composition	No	No	No	Yes
N	2961	2961	2954	2954

Notes: The outcomes of interest come from principal responses to the survey question: "You indicated that only certain students can participate in some of the opportunities listed in the previous question. Do you use each of the following data sources when deciding which students can participate?". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school poverty quartile and the principals in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 2.

Appendix Table 2B: Factors Considered When Deciding Which Students Can Participate in Advanced Math Courses, by School Racial/Ethnic Composition

	Standardized assessment data is a factor (Bottom quartile mean: 0.73)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	-0.008	0.009	0.011	0.021
	(0.027)	(0.029)	(0.031)	(0.032)
Third	-0.041	-0.035	-0.034	-0.042
	(0.029)	(0.034)	(0.037)	(0.040)
Top	-0.049*	-0.033	-0.027	-0.017
	(0.029)	(0.035)	(0.040)	(0.048)
	Principals' knowledge of student is a factor (Bottom quartile mean: 0.40)			
Second	-0.061***	-0.063***	-0.043*	-0.043*
	(0.022)	(0.024)	(0.025)	(0.026)
Third	-0.052**	-0.058**	-0.025	-0.036
	(0.024)	(0.029)	(0.030)	(0.032)
Top	-0.008	-0.012	0.018	0.003
	(0.026)	(0.031)	(0.033)	(0.040)
	Parent request is a factor (Bottom quartile mean: 0.53)			
Second	0.006	-0.022	-0.020	-0.003
	(0.028)	(0.029)	(0.031)	(0.032)
Third	0.004	-0.026	-0.016	-0.000
	(0.029)	(0.033)	(0.036)	(0.039)
Top	-0.038	-0.063*	-0.044	-0.005
	(0.030)	(0.034)	(0.039)	(0.048)
	Teacher referral is a factor (Bottom quartile mean: 0.75)			
Second	-0.026	-0.037	-0.035	-0.024
	(0.027)	(0.029)	(0.031)	(0.031)
Third	-0.104***	-0.119***	-0.113***	-0.112***
	(0.030)	(0.034)	(0.037)	(0.039)
Top	-0.095***	-0.096***	-0.082**	-0.077
	(0.029)	(0.035)	(0.040)	(0.049)
	Prior course grade is a factor (Bottom quartile mean: 0.78)			
Second	-0.043	-0.057**	-0.051*	-0.048
	(0.026)	(0.029)	(0.030)	(0.031)
Third	-0.050*	-0.067**	-0.054	-0.062*
	(0.027)	(0.032)	(0.035)	(0.037)
Top	-0.102***	-0.109***	-0.084**	-0.064
	(0.029)	(0.034)	(0.039)	(0.046)
	Counselor referral is a factor (Bottom quartile mean: 0.48)			
Second	-0.038	-0.062**	-0.066**	-0.053
	(0.029)	(0.031)	(0.033)	(0.034)
Third	-0.055**	-0.067**	-0.066*	-0.061
	(0.028)	(0.033)	(0.036)	(0.039)
Top	0.001	-0.012	0.003	0.006
	(0.029)	(0.034)	(0.038)	(0.048)
State fixed effects	No	Yes	Yes	Yes

School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3093	3093	3088	3088

Notes: The outcomes of interest come from principal responses to the survey question: “You indicated that only certain students can participate in some of the opportunities listed in the previous question. Do you use each of the following data sources when deciding which students can participate?”. We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the principals in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 2.

Appendix Table 3A: Achievement Grouping in Math Courses: Grades 6-8, by School Poverty Quartile

	Achievement grouping across math courses (Bottom quartile mean: 0.33)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	-0.054*	-0.074**	-0.067**	-0.041
	(0.030)	(0.030)	(0.030)	(0.030)
Third	-0.041	-0.072**	-0.066**	-0.018
	(0.031)	(0.031)	(0.033)	(0.034)
Top	-0.124***	-0.150***	-0.151***	-0.067
	(0.030)	(0.031)	(0.034)	(0.041)
	Achievement grouping within math courses (Bottom quartile mean: 0.13)			
Second	0.035	0.049**	0.041*	0.045*
	(0.022)	(0.023)	(0.023)	(0.024)
Third	0.034	0.064***	0.051**	0.054*
	(0.023)	(0.024)	(0.025)	(0.028)
Top	0.109***	0.133***	0.126***	0.125***
	(0.027)	(0.028)	(0.029)	(0.035)
	No achievement grouping (Bottom quartile mean: 0.09)			
Second	0.073***	0.086***	0.069***	0.071***
	(0.020)	(0.021)	(0.021)	(0.023)
Third	0.119***	0.150***	0.118***	0.128***
	(0.024)	(0.025)	(0.026)	(0.029)
Top	0.149***	0.162***	0.132***	0.157***
	(0.025)	(0.026)	(0.029)	(0.037)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3563	3563	3556	3556

Notes: The outcomes of interest come from principal responses to the survey question: "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? Grades 6-8". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school poverty quartile and the principals in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 3.

Appendix Table 3B: Achievement Grouping in Math Courses: Grades 6-8, by School Racial/Ethnic Composition

	Achievement grouping across math courses (Bottom quartile mean: 0.27)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	0.086***	0.071**	0.041	0.056*
	(0.030)	(0.032)	(0.033)	(0.034)
Third	0.035	0.011	-0.033	-0.017
	(0.030)	(0.035)	(0.037)	(0.038)
Top	-0.060**	-0.083**	-0.138***	-0.098**
	(0.028)	(0.034)	(0.039)	(0.045)
	Achievement grouping within math courses (Bottom quartile mean: 0.18)			
Second	-0.036	-0.008	0.017	0.009
	(0.023)	(0.023)	(0.024)	(0.024)
Third	-0.052**	-0.025	0.009	-0.032
	(0.023)	(0.025)	(0.026)	(0.029)
Top	0.019	0.048*	0.076***	-0.014
	(0.025)	(0.028)	(0.029)	(0.034)
	No achievement grouping (Bottom quartile mean: 0.21)			
Second	-0.069***	-0.052**	-0.013	-0.034
	(0.023)	(0.026)	(0.026)	(0.025)
Third	-0.035	-0.018	0.033	-0.008
	(0.025)	(0.030)	(0.030)	(0.031)
Top	-0.036	-0.011	0.021	-0.064*
	(0.024)	(0.029)	(0.031)	(0.037)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3720	3720	3714	3714

Notes: The outcomes of interest come from principal responses to the survey question: "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? Grades 6-8". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the principals in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 3.

Appendix Table 4A: Math Courses Offered in Grades 7 and 8 Other than Algebra I, by School Poverty Quartile

	General math (Bottom quartile mean: 0.56)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	0.022	0.028	0.014	0.041
	(0.033)	(0.032)	(0.032)	(0.033)
Third	0.077**	0.094***	0.064*	0.117***
	(0.033)	(0.033)	(0.034)	(0.037)
Top	0.118***	0.124***	0.101***	0.196***
	(0.034)	(0.035)	(0.038)	(0.045)
	Pre-algebra (Bottom quartile mean: 0.41)			
Second	0.012	0.025	0.029	0.046
	(0.032)	(0.030)	(0.030)	(0.031)
Third	0.003	0.051	0.055	0.093***
	(0.034)	(0.032)	(0.034)	(0.036)
Top	-0.094***	-0.072**	-0.047	0.029
	(0.033)	(0.034)	(0.035)	(0.043)
	Algebra II (Bottom quartile mean: 0.33)			
Second	-0.002	0.002	0.005	0.004
	(0.025)	(0.024)	(0.024)	(0.025)
Third	-0.062**	-0.047*	-0.033	-0.039
	(0.025)	(0.025)	(0.026)	(0.028)
Top	-0.055**	-0.053**	-0.020	-0.033
	(0.026)	(0.027)	(0.029)	(0.036)
	Geometry (Bottom quartile mean: 0.46)			
Second	-0.053*	-0.064**	-0.052*	-0.051*
	(0.028)	(0.026)	(0.027)	(0.027)
Third	-0.123***	-0.134***	-0.109***	-0.112***
	(0.028)	(0.028)	(0.030)	(0.031)
Top	-0.158***	-0.169***	-0.130***	-0.138***
	(0.028)	(0.029)	(0.032)	(0.038)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3563	3563	3556	3556

Notes: The outcomes of interest come from principal responses to the survey question: "This school year, which of the following mathematics and computer science courses are offered on site at your school for students in any grades 7 through 8? SELECT ALL THAT APPLY". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school poverty quartile and the principals in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 4.

Appendix Table 4B: Math Courses Offered in Grades 7 and 8 Other than Algebra I, by School Racial/Ethnic Composition

	General math (Bottom quartile mean: 0.64)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	-0.026	-0.003	0.029	0.025
	(0.031)	(0.034)	(0.034)	(0.035)
Third	-0.047	-0.035	0.006	-0.038
	(0.033)	(0.037)	(0.039)	(0.042)
Top	-0.055*	-0.040	-0.023	-0.133**
	(0.033)	(0.039)	(0.044)	(0.052)
	Pre-algebra (Bottom quartile mean: 0.44)			
Second	-0.019	0.020	0.032	0.033
	(0.032)	(0.033)	(0.034)	(0.035)
Third	-0.063*	0.001	0.029	0.016
	(0.032)	(0.036)	(0.038)	(0.041)
Top	-0.169***	-0.101***	-0.066*	-0.069
	(0.031)	(0.036)	(0.040)	(0.048)
	Algebra II (Bottom quartile mean: 0.34)			
Second	-0.078***	-0.062**	-0.059**	-0.060**
	(0.025)	(0.026)	(0.027)	(0.027)
Third	-0.106***	-0.065**	-0.052*	-0.038
	(0.025)	(0.028)	(0.030)	(0.032)
Top	-0.098***	-0.063**	-0.028	0.007
	(0.025)	(0.028)	(0.032)	(0.039)
	Geometry (Bottom quartile mean: 0.39)			
Second	0.004	-0.006	-0.026	-0.027
	(0.027)	(0.028)	(0.029)	(0.029)
Third	-0.048*	-0.045	-0.063**	-0.026
	(0.028)	(0.031)	(0.032)	(0.034)
Top	-0.089***	-0.082***	-0.076**	0.017
	(0.026)	(0.030)	(0.035)	(0.040)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3720	3720	3714	3714

Notes: The outcomes of interest come from principal responses to the survey question: “This school year, which of the following mathematics and computer science courses are offered on site at your school for students in any grades 7 through 8? SELECT ALL THAT APPLY”. We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the principals in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 4.

Appendix Table 5A: Math Courses Offered in Grades 7 and 8 Other than Algebra I: Grades 6-8, by School Poverty Quartile

	General math (Bottom quartile mean: 0.56)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	0.022	0.028	0.014	0.041
	(0.033)	(0.032)	(0.032)	(0.033)
Third	0.077**	0.094***	0.064*	0.117***
	(0.033)	(0.033)	(0.034)	(0.037)
Top	0.118***	0.124***	0.101***	0.196***
	(0.034)	(0.035)	(0.038)	(0.045)
	Pre-algebra (Bottom quartile mean: 0.41)			
Second	0.012	0.025	0.029	0.046
	(0.032)	(0.030)	(0.030)	(0.031)
Third	0.003	0.051	0.055	0.093***
	(0.034)	(0.032)	(0.034)	(0.036)
Top	-0.094***	-0.072**	-0.047	0.029
	(0.033)	(0.034)	(0.035)	(0.043)
	Algebra II (Bottom quartile mean: 0.33)			
Second	-0.002	0.002	0.005	0.004
	(0.025)	(0.024)	(0.024)	(0.025)
Third	-0.062**	-0.047*	-0.033	-0.039
	(0.025)	(0.025)	(0.026)	(0.028)
Top	-0.055**	-0.053**	-0.020	-0.033
	(0.026)	(0.027)	(0.029)	(0.036)
	Geometry (Bottom quartile mean: 0.46)			
Second	-0.053*	-0.064**	-0.052*	-0.051*
	(0.028)	(0.026)	(0.027)	(0.027)
Third	-0.123***	-0.134***	-0.109***	-0.112***
	(0.028)	(0.028)	(0.030)	(0.031)
Top	-0.158***	-0.169***	-0.130***	-0.138***
	(0.028)	(0.029)	(0.032)	(0.038)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3563	3563	3556	3556

Notes: The outcomes of interest come from principal responses to the survey question: "This school year, which of the following mathematics and computer science courses are offered on site at your school for students in any grades 7 through 8? SELECT ALL THAT APPLY". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school poverty quartile and the principals in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 4.

Appendix Table 5B: Math Courses Offered in Grades 7 and 8 Other than Algebra I, by School Racial/Ethnic Composition

	General math (Bottom quartile mean: 0.64)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	-0.026	-0.003	0.029	0.039
	(0.031)	(0.034)	(0.034)	(0.040)
Third	-0.047	-0.035	0.006	0.037
	(0.033)	(0.037)	(0.039)	(0.076)
Top	-0.055*	-0.040	-0.023	0.034
	(0.033)	(0.039)	(0.044)	(0.130)
	Pre-algebra (Bottom quartile mean: 0.44)			
Second	-0.019	0.020	0.032	0.085**
	(0.032)	(0.033)	(0.034)	(0.040)
Third	-0.063*	0.001	0.029	0.191**
	(0.032)	(0.036)	(0.038)	(0.075)
Top	-0.169***	-0.101***	-0.066*	0.236*
	(0.031)	(0.036)	(0.040)	(0.124)
	Algebra II (Bottom quartile mean: 0.34)			
Second	-0.078***	-0.062**	-0.059**	-0.033
	(0.025)	(0.026)	(0.027)	(0.032)
Third	-0.106***	-0.065**	-0.052*	0.028
	(0.025)	(0.028)	(0.030)	(0.060)
Top	-0.098***	-0.063**	-0.028	0.120
	(0.025)	(0.028)	(0.032)	(0.100)
	Geometry (Bottom quartile mean: 0.39)			
Second	0.004	-0.006	-0.026	0.008
	(0.027)	(0.028)	(0.029)	(0.034)
Third	-0.048*	-0.045	-0.063**	0.043
	(0.028)	(0.031)	(0.032)	(0.064)
Top	-0.089***	-0.082***	-0.076**	0.120
	(0.026)	(0.030)	(0.035)	(0.110)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	3720	3720	3714	3714

Notes: The outcomes of interest come from principal responses to the survey question: "This school year, which of the following mathematics and computer science courses are offered on site at your school for students in any grades 7 through 8? SELECT ALL THAT APPLY". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the principals in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 4.

Appendix Table 6A: Instruction Time in Algebra, by School Poverty Quartile

	Minutes per week (Bottom quartile mean: 269)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	30.734	32.059	30.856	33.462
	(22.105)	(23.468)	(23.496)	(25.388)
Third	5.439	1.359	3.967	7.778
	(17.913)	(20.626)	(21.136)	(24.277)
Top	-12.416	-11.512	-7.462	-2.045
	(17.590)	(19.174)	(20.214)	(25.235)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	871	871	870	870

Notes: The outcomes of interest come from principal responses to the survey question: "Average weekly instructional minutes for Algebra I.". We restrict the analysis to principals who indicated that their school served 8^{th} or 9^{th} grade. Each estimate presents the difference in principal responses between the schools in the bottom school poverty quartile and the principals in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 5.

Appendix Table 6B: Instruction Time in Algebra, by School Poverty Quartile

	Minutes per week (Bottom quartile mean: 277)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	12.886	-0.927	4.497	1.791
	(21.537)	(23.429)	(23.137)	(24.638)
Third	0.399	-7.574	1.193	-14.993
	(19.710)	(22.374)	(23.706)	(27.222)
Top	-26.777	-28.056	-15.108	-26.593
	(19.695)	(22.485)	(21.687)	(28.376)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	908	908	906	906

Notes: The outcomes of interest come from principal responses to the survey question: "Average weekly instructional minutes for Algebra I.". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. We restrict the analysis to principals who indicated that their school served 8th or 9th grade. Each estimate presents the difference in principal responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the principals in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 4.

Appendix Table 7A: 8th and 9th Grade Math Teachers: Credential Subject Area and Specialization, by School Poverty Quartile

		Multi-subject credential (Bottom quartile mean: 0.32)		
School poverty quartile	(I)	(II)	(III)	(IV)
Second	-0.007	-0.015	-0.023	0.024
	(0.056)	(0.058)	(0.059)	(0.062)
Third	0.143**	0.056	0.050	0.137*
	(0.063)	(0.064)	(0.066)	(0.075)
Top	0.000	-0.037	-0.031	0.122
	(0.066)	(0.067)	(0.070)	(0.085)
		Single-subject mathematics (Bottom quartile mean: 0.60)		
Second	0.050	0.085	0.105*	0.092
	(0.058)	(0.058)	(0.059)	(0.064)
Third	-0.063	0.016	0.033	0.006
	(0.065)	(0.065)	(0.068)	(0.077)
Top	-0.120*	-0.064	-0.064	-0.112
	(0.070)	(0.070)	(0.075)	(0.090)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	654	654	653	653

Notes: The outcomes of interest come from teacher responses to the survey question: “In what subject area(s), specialization(s), or grade(s) do you hold a teacher credential? SELECT ALL THAT APPLY”. We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school poverty quartile and the teachers in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 6.

Appendix Table 7B: 8th and 9th Grade Math Teachers: Credential Subject Area and Specialization, by School Racial/Ethnic Composition

		Multi-subject credential (Bottom quartile mean: 0.40)		
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	-0.004	0.049	0.058	0.044
	(0.065)	(0.067)	(0.068)	(0.068)
Third	-0.049	0.015	0.026	-0.009
	(0.063)	(0.069)	(0.070)	(0.076)
Top	-0.109*	-0.054	-0.038	-0.074
	(0.063)	(0.072)	(0.073)	(0.089)
		Single-subject mathematics (Bottom quartile mean: 0.53)		
Second	0.058	-0.025	-0.038	-0.043
	(0.066)	(0.069)	(0.070)	(0.069)
Third	0.099	0.001	-0.021	-0.016
	(0.064)	(0.068)	(0.071)	(0.078)
Top	0.050	-0.022	-0.050	0.003
	(0.067)	(0.074)	(0.077)	(0.091)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School poverty	No	No	No	Yes
N	692	692	691	653

Notes: The outcomes of interest come from teacher responses to the survey question: "In what subject area(s), specialization(s), or grade(s) do you hold a teacher credential? SELECT ALL THAT APPLY". We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the teachers in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 6.

Appendix Table 8A: 8th and 9th Grade Math Teachers: Teacher Preparation Program, by School Poverty Quartile

	Undergraduate program only (Bottom quartile mean: 0.46)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	0.021	0.013	0.006	-0.033
	(0.048)	(0.046)	(0.048)	(0.068)
Third	0.017	0.005	0.000	0.026
	(0.051)	(0.048)	(0.050)	(0.075)
Top	0.029	0.029	0.034	0.045
	(0.055)	(0.056)	(0.058)	(0.090)
	Graduate program only (Bottom quartile mean: 0.48)			
Second	-0.095**	-0.074*	-0.061	0.030
	(0.048)	(0.044)	(0.046)	(0.065)
Third	-0.146***	-0.110**	-0.095**	-0.090
	(0.047)	(0.045)	(0.046)	(0.069)
Top	-0.158***	-0.128**	-0.108**	0.041
	(0.052)	(0.050)	(0.052)	(0.087)
	Program that included both undergraduate and post-baccalaureate components (Bottom quartile mean: 0.15)			
Second	-0.010	-0.007	-0.016	0.023
	(0.031)	(0.032)	(0.034)	(0.054)
Third	0.024	0.030	0.017	0.064
	(0.034)	(0.036)	(0.037)	(0.062)
Top	0.028	0.021	0.010	0.029
	(0.037)	(0.039)	(0.041)	(0.082)
	Alternative certification programs (Bottom quartile mean: 0.12)			
Second	0.064	0.077*	0.063	0.015
	(0.044)	(0.044)	(0.045)	(0.049)
Third	0.119**	0.116**	0.096*	0.021
	(0.051)	(0.056)	(0.056)	(0.062)
Top	0.177***	0.164**	0.120*	0.012
	(0.059)	(0.065)	(0.067)	(0.078)
	Did not student teach as part of teacher preparation program (Bottom quartile mean: 0.12)			
Second	0.039	0.018	0.020	0.036
	(0.033)	(0.032)	(0.034)	(0.051)
Third	0.037	-0.009	-0.007	-0.056
	(0.035)	(0.035)	(0.039)	(0.056)
Top	0.115**	0.093*	0.089*	0.046
	(0.046)	(0.048)	(0.051)	(0.076)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	1064	1064	1062	654

Notes: The outcomes of interest come from teacher responses to the survey questions: “How would you describe the teacher preparation program you completed?” and “As part of your teacher preparation, how long did you student teach?”. We restrict the analysis to 8^{th} and 9^{th} grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school poverty quartile and the teachers in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 7.

Appendix Table 8B: 8th and 9th Grade Math Teachers: Teacher Preparation Program, by School Racial/Ethnic Composition

	Undergraduate program only (Bottom quartile mean: 0.51)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	-0.046	0.048	0.057	0.062
	(0.066)	(0.068)	(0.069)	(0.071)
Third	-0.201***	-0.077	-0.067	-0.080
	(0.062)	(0.071)	(0.073)	(0.079)
Top	-0.177***	-0.007	0.009	-0.016
	(0.065)	(0.074)	(0.078)	(0.099)
	Graduate program only (Bottom quartile mean: 0.33)			
Second	-0.082	-0.084	-0.089	-0.092
	(0.057)	(0.060)	(0.061)	(0.064)
Third	-0.008	-0.005	0.002	0.006
	(0.059)	(0.066)	(0.068)	(0.073)
Top	-0.012	-0.005	0.007	0.000
	(0.062)	(0.067)	(0.069)	(0.083)
	Program that included both undergraduate and post-baccalaureate components (Bottom quartile mean: 0.21)			
Second	0.008	-0.018	-0.024	-0.042
	(0.051)	(0.056)	(0.059)	(0.062)
Third	-0.041	-0.041	-0.051	-0.061
	(0.048)	(0.056)	(0.062)	(0.071)
Top	-0.043	-0.067	-0.080	-0.092
	(0.049)	(0.057)	(0.063)	(0.084)
	Alternative certification programs (Bottom quartile mean: 0.08)			
Second	0.072*	0.033	0.040	0.054
	(0.043)	(0.043)	(0.043)	(0.045)
Third	0.165***	0.112**	0.112**	0.119**
	(0.045)	(0.051)	(0.051)	(0.057)
Top	0.250***	0.197***	0.189***	0.191***
	(0.052)	(0.060)	(0.059)	(0.070)
	Did not student teach as part of teacher preparation program (Bottom quartile mean: 0.12)			
Second	0.031	-0.018	-0.007	0.000
	(0.045)	(0.048)	(0.050)	(0.052)
Third	0.094**	0.000	0.019	0.015
	(0.046)	(0.055)	(0.056)	(0.061)
Top	0.142***	0.044	0.061	0.048
	(0.051)	(0.061)	(0.065)	(0.076)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes

N	693	693	692	654

Notes: The outcomes of interest come from teacher responses to the survey questions: "How would you describe the teacher preparation program you completed?" and "As part of your teacher preparation, how long did you student teach?". We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the teachers in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 7.

Appendix Table 9A: 8th and 9th Grade Math Teachers: Fulfilled Teacher Licensure Requirements, by School Poverty Quartile

	Completed all the teacher licensure requirements for math (Bottom quartile mean: 0.93)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	0.031	0.046	0.052*	0.093***
	(0.029)	(0.029)	(0.030)	(0.035)
Third	0.017	0.029	0.039	0.111**
	(0.032)	(0.038)	(0.039)	(0.045)
Top	-0.087*	-0.081*	-0.052	0.062
	(0.048)	(0.042)	(0.039)	(0.053)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	655	655	654	654

Notes: The outcomes of interest come from teacher responses to the survey question: "Please indicate which of the following best represents when or if you've fulfilled all the teacher licensure requirements in your state in mathematics for the grade(s) you teach.". We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school poverty quartile and the teachers in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 8.

Appendix Table 9B: 8th and 9th Grade Math Teachers: Teacher Preparation Program, by School Racial/Ethnic Composition

	Completed all the teacher licensure requirements for math (Bottom quartile mean: 0.94)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	0.022	0.003	-0.003	0.003
	(0.030)	(0.029)	(0.030)	(0.028)
Third	-0.002	-0.020	-0.026	-0.047
	(0.033)	(0.032)	(0.036)	(0.040)
Top	-0.071*	-0.098**	-0.097**	-0.109**
	(0.040)	(0.041)	(0.041)	(0.046)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	693	693	692	654

Notes: The outcomes of interest come from teacher responses to the survey question: "Please indicate which of the following best represents when or if you've fulfilled all the teacher licensure requirements in your state in mathematics for the grade(s) you teach.". We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the teachers in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 8.

Appendix Table 10A: Classroom Activities for Teachers in 8th and 9th Grade Math Courses, by School Poverty Quartile

	In a typical week, spend more than 50% of time in…			
	…addressing mathematics topics below their grade level (bottom quartile mean: 0.21)			
School poverty quartile	(I)	(II)	(III)	(IV)
Second	-0.000	0.024	0.041	0.050
	(0.038)	(0.040)	(0.042)	(0.055)
Third	0.012	0.022	0.042	0.031
	(0.040)	(0.043)	(0.045)	(0.068)
Top	0.136***	0.162***	0.176***	0.189**
	(0.048)	(0.048)	(0.050)	(0.084)
	…providing mathematics instruction verbally, excluding classroom discussion (Bottom quartile mean: 0.18)			
Second	0.032	-0.015	-0.031	-0.046
	(0.046)	(0.049)	(0.051)	(0.054)
Third	0.023	-0.039	-0.058	-0.095
	(0.048)	(0.054)	(0.057)	(0.070)
Top	0.246***	0.193***	0.174**	0.121
	(0.064)	(0.065)	(0.070)	(0.095)
	…taking a test or quiz (Bottom quartile mean: 0.08)			
Second	0.024	0.023	0.018	0.084**
	(0.026)	(0.027)	(0.029)	(0.041)
Third	-0.022	-0.026	-0.034	0.012
	(0.022)	(0.023)	(0.026)	(0.045)
Top	0.090**	0.086**	0.077*	0.129**
	(0.035)	(0.039)	(0.040)	(0.064)
	…maintaining order/disciplining students (Bottom quartile mean: 0.14)			
Second	0.059	0.040	0.048	0.017
	(0.045)	(0.048)	(0.050)	(0.054)
Third	-0.011	-0.059	-0.054	-0.106
	(0.045)	(0.049)	(0.052)	(0.065)
Top	0.184***	0.174***	0.166***	0.098
	(0.061)	(0.059)	(0.063)	(0.080)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	1073	1073	1071	663

Notes: The outcomes of interest come from teacher responses to the survey question: "In a typical week, indicate about what percent of your time is spent doing the following activities with your typical math class. Percentages do not need to add up to 100 percent.". We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school poverty quartile and the teachers in schools in the corresponding school poverty quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the left panel of Figure 9.

Appendix Table 10B: Classroom Activities for Teachers in 8th and 9th Grade Math Courses, by School Racial/Ethnic Composition

	In a typical week, spend more than 50% of time in…			
	…addressing mathematics topics below their grade level (bottom quartile mean: 0.21)			
School Black/Hispanic student share quartile	(I)	(II)	(III)	(IV)
Second	-0.075	-0.043	-0.045	-0.047
	(0.049)	(0.056)	(0.058)	(0.059)
Third	0.025	0.061	0.055	0.012
	(0.055)	(0.063)	(0.066)	(0.072)
Top	0.017	0.055	0.042	-0.043
	(0.056)	(0.068)	(0.069)	(0.082)
	…providing mathematics instruction verbally, excluding classroom discussion (Bottom quartile mean: 0.21)			
Second	-0.026	-0.056	-0.053	-0.052
	(0.052)	(0.056)	(0.057)	(0.058)
Third	0.018	-0.033	-0.031	-0.010
	(0.053)	(0.064)	(0.067)	(0.073)
Top	0.141**	0.092	0.086	0.084
	(0.060)	(0.069)	(0.072)	(0.095)
	…taking a test or quiz (Bottom quartile mean: 0.06)			
Second	0.044	0.055	0.059*	0.064*
	(0.037)	(0.035)	(0.035)	(0.035)
Third	0.009	0.016	0.026	0.003
	(0.031)	(0.037)	(0.036)	(0.042)
Top	0.112***	0.126***	0.139***	0.125**
	(0.043)	(0.048)	(0.048)	(0.061)
	…maintaining order/disciplining students (Bottom quartile mean: 0.18)			
Second	-0.053	-0.025	-0.042	-0.067
	(0.048)	(0.053)	(0.053)	(0.055)
Third	0.047	0.075	0.056	0.028
	(0.052)	(0.060)	(0.061)	(0.066)
Top	0.092	0.110*	0.080	0.038
	(0.056)	(0.063)	(0.062)	(0.072)
State fixed effects	No	Yes	Yes	Yes
School urbanicity and size	No	No	Yes	Yes
School racial composition	No	No	No	Yes
N	702	702	701	663

Notes: The outcomes of interest come from teacher responses to the survey question: "In a typical week, indicate about what percent of your time is spent doing the following activities with your typical math class. Percentages do not need to add up to 100 percent.". We restrict the analysis to 8th and 9th grade math teachers. Each estimate presents the difference in teacher responses between the schools in the bottom school quartile based on the share of Black/Hispanic students and the teachers in schools in the corresponding Black/Hispanic share quartile, using only survey-year fixed effects in column (I); introducing state fixed effects in column (II); introducing school urbanicity and size in column (III); and introducing measures of school racial/ethnic composition in column (IV). *, **, and *** imply that the estimate is statistically different than zero at 10, 5, and 1 percent respectively. Robust standard errors clustered at the school level are given in parentheses. The estimates present the numbers behind the right panel of Figure 9.

Appendix C: Focus States

In this appendix, we take a closer look at algebra learning and teaching experiences in three large states (California, Florida, and Texas) where we gathered survey data from oversamples of teachers and principals. In particular, we first examine the differences between the three states in (1) 8th grade algebra offering; (2) factors considered for access to advanced math courses in 8th and 9th grades; (3) achievement grouping in middle school math courses; (4) math courses offered in 8th and 9th grades other than Algebra I; and (5) teacher characteristics and classroom activities in 8th and 9th grade math courses. We then look into the discrepancies in (1)-(4) across school settings in each state (we are unable to conduct the same analysis using teacher survey responses due to small sample sizes). Several findings emerge from our analysis.

First, we show that principals in Florida and Texas were significantly less likely to report that their school does not offer algebra in 8th grade, and more likely to report that their school offers algebra for all students. The findings presented in the top panel of Appendix Table C1 suggest that roughly one-third of principals in California public schools reported that their school does not offer algebra in 8th grade, which is in stark contrast to Florida and Texas where only 1 and 9 percent of principals responded similarly (both California-Florida and California-Texas differences are statistically distinguishable from zero at 5 percent level). Likewise, only one-third of principals in California reported that their school offers 8th grade unconditionally for all students, compared to 48 percent in Florida and 46 percent in Texas. Appendix Figure C1 examines the discrepancies across school settings along these two measures in each state. In California and Texas, principals in highest-poverty schools were more likely to report that their school does not offer 8th grade algebra (or offer it unconditionally for all students), while we find no such differences in Florida. Our findings also do not reveal any significant differences along the racial/ethnic composition of schools in each state.

Second, our findings reveal important differences across states in factors that are considered when placing students into advanced math courses. For example, the second panel of Appendix Table C1 reveals that 84 and 82 percent of principals in Florida reported that they use standardized test scores and prior course grades as criteria respectively (74 percent for Texas) while these numbers are 47 and 52 percent in California. Principals in Florida and Texas were also more likely to use teacher referrals in advanced math course placement compared to principals in California. Looking at the discrepancies across school settings in the three states (presented in Appendix Figure C2), we find that standardized test scores and prior course grades were significantly less likely to be used in California in highest-poverty school settings while prior course grades were less likely to be used in Texas in highest-Black/Hispanic share schools.

Third, principals in Florida were significantly more likely to report that they engage in achievement grouping across math courses (52 percent in Florida compared to 23 percent in California and 21 percent in Texas) while principals in California and Texas were more likely to report that they do not engage in achievement grouping in math courses (16 percent in California and 17 percent in Texas compared to 6 percent in Florida). Appendix Figure C3 also suggests that principals in highest-poverty schools were less likely to engage in achievement grouping across math courses (especially in California and Texas) although these differences are not statistically distinguishable from zero at conventional levels in almost all cases.

Fourth, our findings also reveal important differences in math course offerings in 7th and 8th grades as well as the likelihood of offering AP Calculus or AP Statistics in high school between the three states. Principals in Florida were significantly more likely to report that their school offers pre-algebra and geometry in 7th and 8th grades compared to principals in California and Texas. In contrast, they were significantly less likely to report that their school offers AP Calculus or AP Statistics compared to principals in California and Texas. Appendix Figures C4 and B5 reveal that, similar to our findings at the national level, highest-poverty schools in these three states are less likely to offer advanced math courses (geometry in 7th or 8th grades, or AP Calculus in high school) compared to schools serving students from more affluent families.

Finally, Appendix Table C2 reveal some differences between 8th and 9th grade math teacher characteristics in the three states. The most striking of these differences is the likelihood of 8th and 9th grade math teachers completing alternative certification programs. In Florida and Texas, nearly one-third of these teachers completed alternative certification programs, in stark contrast to California where only 16 percent of 8th and 9th grade math teachers completed alternative certification programs. Math teachers in California are also less likely to report that they did not student teach as part of their teacher preparation program (21 percent in California versus 28 percent in Florida and 27 percent in Texas). We do not find any significant differences in the likelihood that the teachers fulfilled all of the licensure requirements of their states or classroom activities with two exceptions: 8th and 9th grade math teachers in California were more likely to report that they spend more than half of their classroom time addressing math topics below grade level while math teachers in Texas were more likely to report that they spend more than half of their instruction time maintaining order/disciplining students.

Appendix Table C1: Differences in Math Course Offering and Access between Focus States

	8th grade algebra offering		
	California	Florida	Texas
School offers algebra in 8th grade; any student can participate	0.32	0.48	0.46
	[0.24,0.40]	[0.41,0.55]	[0.37,0.56]
School does not offer 8th grade algebra	0.34	0.01	0.09
	[0.25,0.42]	[0.00,0.03]	[0.04,0.13]
N	248	302	242
	Factors considered for access to advanced math courses		
	California	Florida	Texas
Standardized test scores	0.47	0.84	0.74
	[0.39,0.55]	[0.79,0.90]	[0.67,0.80]
Principal knowledge of student	0.22	0.35	0.41
	[0.17,0.27]	[0.30,0.40]	[0.34,0.47]
Parent request	0.45	0.55	0.58
	[0.37,0.52]	[0.49,0.62]	[0.51,0.65]
Teacher referral	0.51	0.71	0.66
	[0.43,0.59]	[0.64,0.77]	[0.59,0.73]
Prior course grade	0.52	0.82	0.74
	[0.44,0.60]	[0.77,0.87]	[0.68,0.80]
Counselor referral	0.36	0.47	0.50
	[0.29,0.42]	[0.41,0.53]	[0.43,0.57]
N	300	374	417
	Achievement grouping in math courses		
	California	Florida	Texas
Achievement grouping across courses	0.23	0.52	0.21
	[0.17,0.29]	[0.46,0.58]	[0.16,0.27]
Achievement grouping within courses	0.16	0.09	0.10
	[0.11,0.21]	[0.06,0.12]	[0.06,0.15]
No achievement tracking	0.16	0.06	0.17
	[0.11,0.21]	[0.03,0.09]	[0.12,0.23]
N	415	436	516
	Math courses offered in 7th and 8th grades (other than Algebra I)		
	California	Florida	Texas
General math	0.58	0.64	0.49
	[0.51,0.64]	[0.59,0.70]	[0.43,0.56]
Pre-algebra	0.21	0.67	0.23
	[0.15,0.27]	[0.61,0.72]	[0.18,0.29]
Algebra II	0.17	0.25	0.30
	[0.12,0.22]	[0.19,0.30]	[0.24,0.35]
Geometry	0.25	0.68	0.32
	[0.18,0.31]	[0.62,0.73]	[0.27,0.37]

N	415	436	516

	Math courses offered in grades 9-12		
	California	Florida	Texas
AP Calculus	0.30	0.24	0.36
	[0.24,0.36]	[0.19,0.30]	[0.30,0.42]
AP Statistics	0.27	0.18	0.26
	[0.21,0.33]	[0.14,0.23]	[0.20,0.32]
N	232	269	296

Notes: The outcomes of interest come from principal responses to the survey questions listed in the notes to Figures 1-4 and Appendix Figure 2. Samples used in the analysis can also be found in the notes to Figures 1-4 and Appendix Figure 2. Each estimate presents the weighted share of principals who agreed with the given response by state while the numbers in brackets present the 95% confidence internals.

Appendix Table C2: Differences in Math Teacher Characteristics and Classroom Activities Between in 8th and 9th Grade Math Courses between Focus States

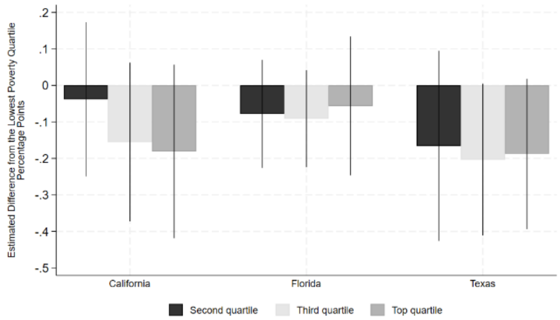
	Teacher preparation program		
	California	Florida	Texas
Alternative certification program	0.16	0.34	0.33
	[0.07,0.26]	[0.25,0.43]	[0.23,0.44]
Did not student teach as part of the program	0.21	0.28	0.27
	[0.13,0.29]	[0.20,0.36]	[0.19,0.36]
N	201	194	151
	Fulfilled teacher licensure requirements		
	California	Florida	Texas
Completed all the teacher licensures requirements for math	0.94	0.90	0.92
	[0.89,0.99]	[0.84,0.96]	[0.85,0.98]
N	201	194	151
	Classroom activities: in a typical week, spend more than 50% of time in…		
	California	Florida	Texas
Addressing math topics below grade level	0.26	0.17	0.19
	[0.19,0.33]	[0.11,0.23]	[0.12,0.26]
Providing mathematics instruction verbally	0.30	0.30	0.27
	[0.20,0.39]	[0.22,0.38]	[0.18,0.37]
Taking a test or quiz	0.10	0.12	0.09
	[0.05,0.16]	[0.07,0.17]	[0.04,0.13]
Maintaining order/disciplining students	0.19	0.18	0.24
	[0.10,0.28]	[0.11,0.26]	[0.15,0.33]
N	201	194	151

Notes: The outcomes of interest come from teacher responses to the survey questions listed in the notes to Figures 7-9. Samples used in the analysis can also be found in the notes to Figures 7-9. Each estimate presents the weighted share of math teachers who agreed with the given response by state while the numbers in brackets present the 95% confidence internals.

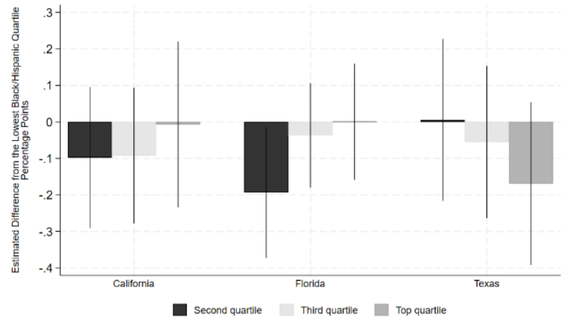
Appendix Figure C1. 8th Grade Algebra: Availability and Access, by School Poverty and Racial/Ethnic Composition in Focus States

School offers algebra in 8th grade; any student can participate

(A) Estimated difference from the lowest school poverty quartile

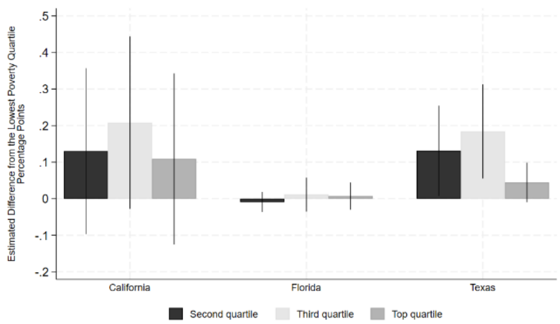


(B) Estimated difference from the bottom quartile in Black/Hispanic share

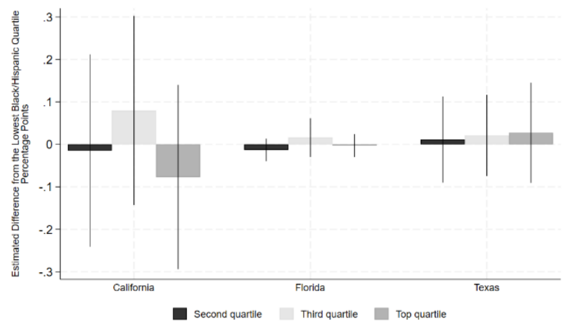


School does not offer algebra in 8th grade

(C) Estimated difference from the lowest school poverty quartile



(D) Estimated difference from the bottom quartile in Black/Hispanic share

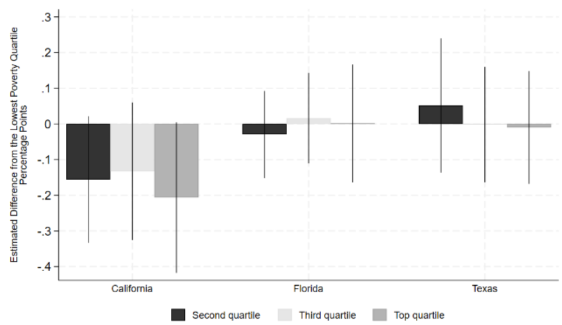


Notes: The outcomes of interest come from principal responses to the survey question: "Indicate if your school offers any of the following opportunities this school year (2023-2024), and which students can participate: Algebra in 8th Grade". We restrict the analysis to principals who indicated that their school served 8th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles by state, using only survey-year fixed-effects as controls. The right panel repeats the same analysis using the share of Black and Hispanic students in the school. Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

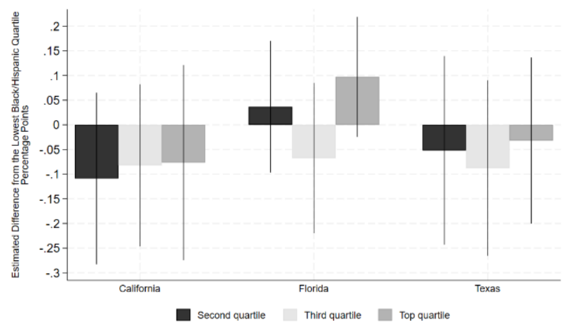
Appendix Figure C2. Factors Considered When Deciding Which Students Can Participate in Advanced Math Courses, by School Poverty and Racial/Ethnic Composition in Focus States

Standardized assessment data is a factor

(A) Estimated difference from the lowest school poverty quartile

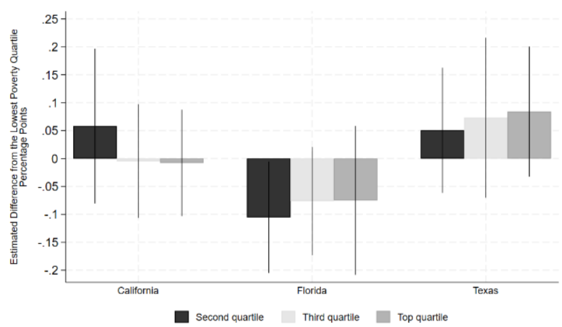


(B) Estimated difference from the bottom quartile in Black/Hispanic share

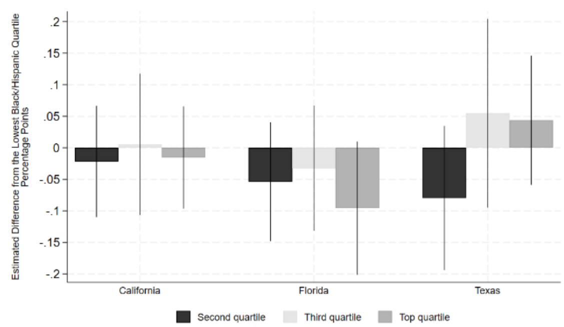


Principals' knowledge of student is a factor

(C) Estimated difference from the lowest school poverty quartile

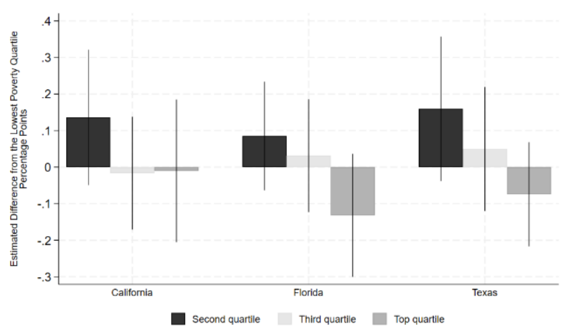


(D) Estimated difference from the bottom quartile in Black/Hispanic share

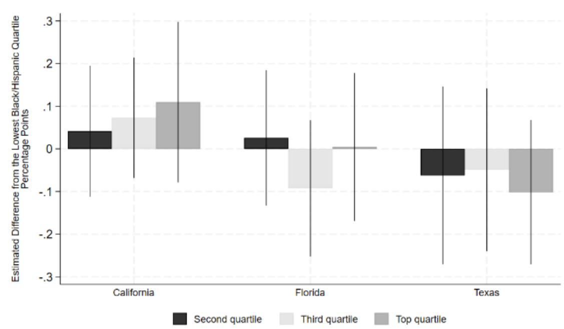


Parent request is a factor

(E) Estimated difference from the lowest school poverty quartile



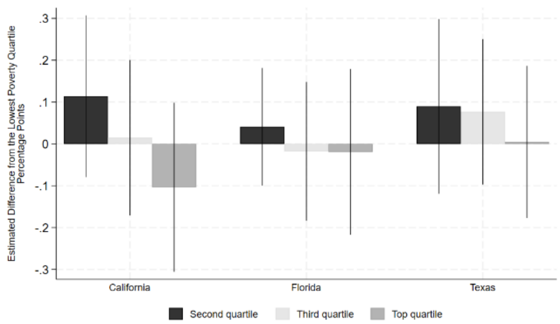
(F) Estimated difference from the bottom quartile in Black/Hispanic share



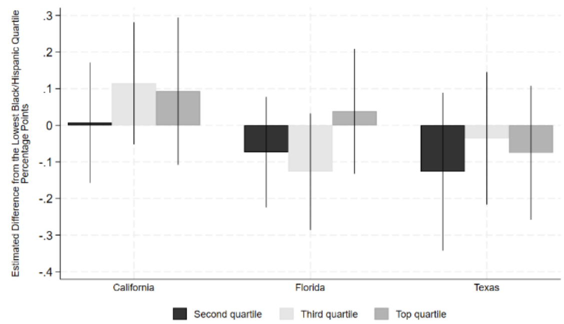
(Appendix Figure C2 continued)

Teacher referral is a factor

(G) Estimated difference from the lowest school poverty quartile

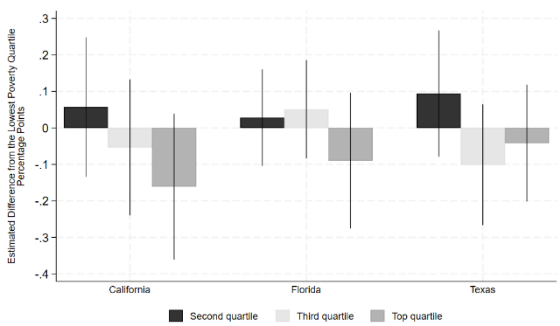


(H) Estimated difference from the bottom quartile in Black/Hispanic share

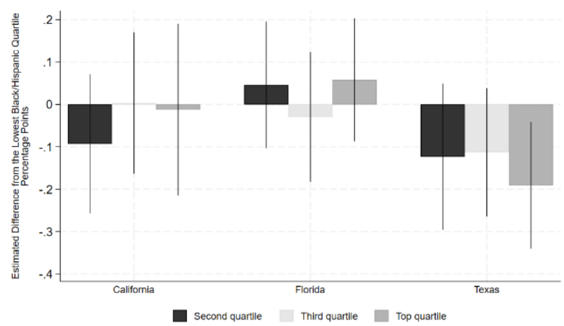


Prior course grade is a factor

(I) Estimated difference from the lowest school poverty quartile

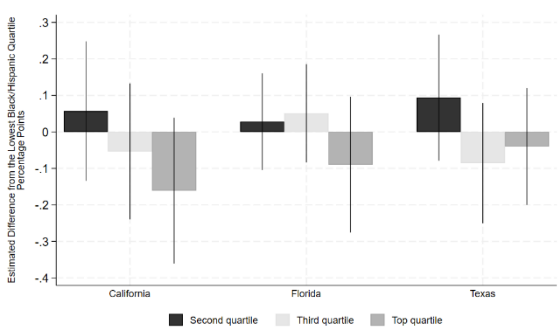


(J) Estimated difference from the bottom quartile in Black/Hispanic share

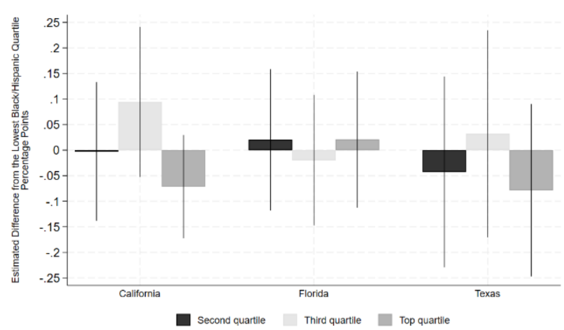


Counselor referral is a factor

(K) Estimated difference from the lowest school poverty quartile



(L) Estimated difference from the bottom quartile in Black/Hispanic share

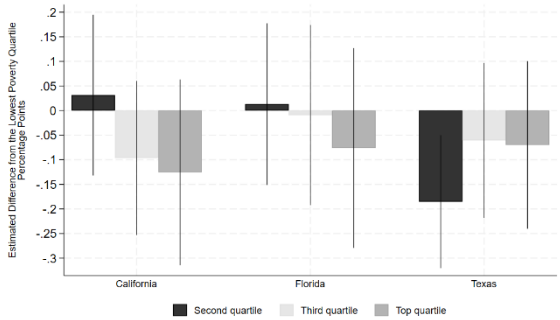


Notes: The outcomes of interest come from principal responses to the survey question: “You indicated that only certain students can participate in some of the opportunities listed in the previous question. Do you use each of the following data sources when deciding which students can participate?”. We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles by state, using only survey-year fixed-effects as controls. The right panel repeats the same analysis using the share of Black and Hispanic students in the school. Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

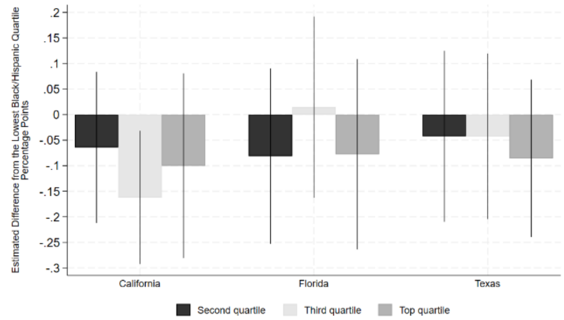
Appendix Figure B3. Achievement Grouping in Math Courses: Grades 6-8, by School Poverty and Racial/Ethnic Composition in Focus States

Achievement grouping across math courses

(A) Estimated difference from the lowest school poverty quartile

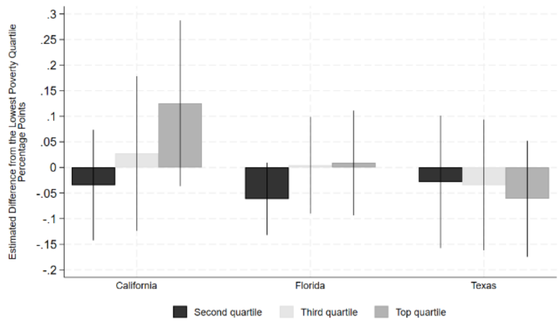


(B) Estimated difference from the bottom quartile in Black/Hispanic share

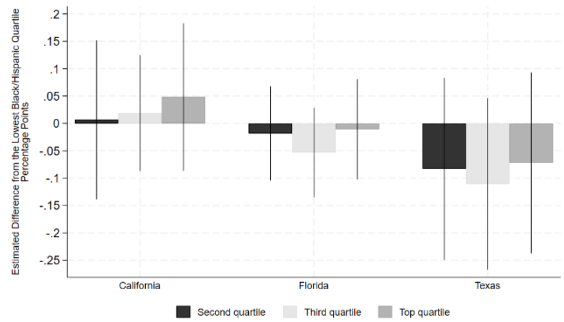


Achievement grouping within math courses

(C) Estimated difference from the lowest school poverty quartile

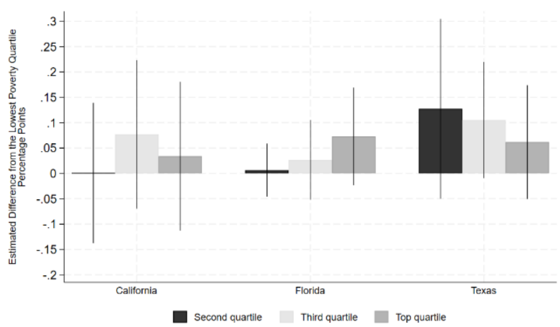


(D) Estimated difference from the bottom quartile in Black/Hispanic share

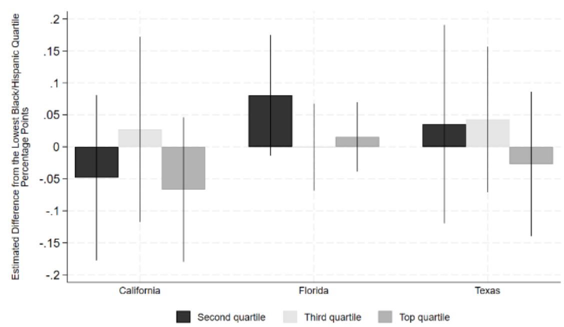


No achievement grouping

(E) Estimated difference from the lowest school poverty quartile



(F) Estimated difference from the bottom quartile in Black/Hispanic share



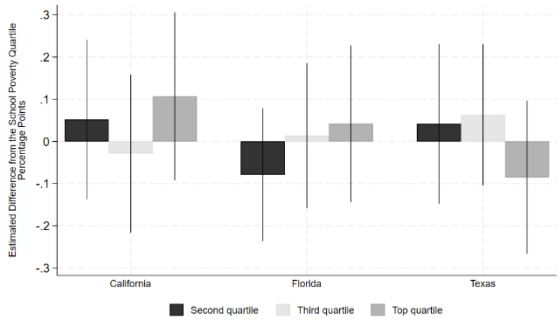
Notes: The outcomes of interest come from principal responses to the survey question: “Some schools organize mathematics instruction differently for students with different achievement levels. What is your school’s policy about

how students are grouped in the following grade bands? Grades 6-8". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles by state, using only survey-year fixed-effects as controls. The right panel repeats the same analysis using the share of Black and Hispanic students in the school. Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

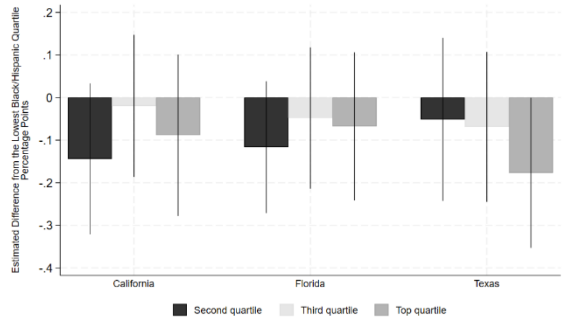
Appendix Figure C4. Math Courses Offered in Grades 7 and 8 Other than Algebra I, by School Poverty and Racial/Ethnic Composition in Focus States

General math

(A) Estimated difference from the lowest school poverty quartile

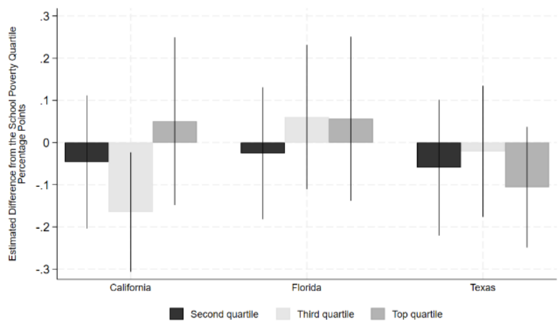


(B) Estimated difference from the bottom quartile in Black/Hispanic share

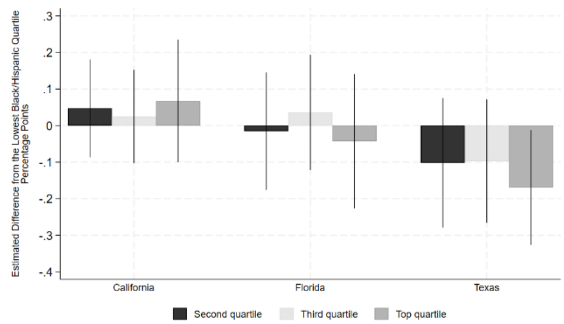


Pre-algebra

(C) Estimated difference from the lowest school poverty quartile

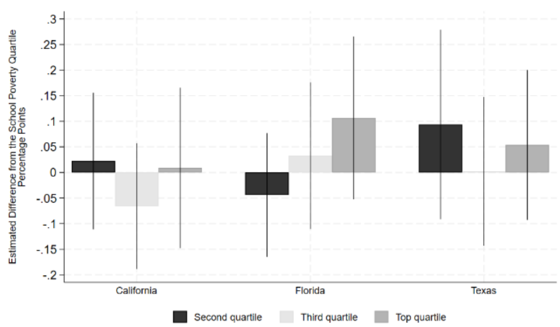


(D) Estimated difference from the bottom quartile in Black/Hispanic share

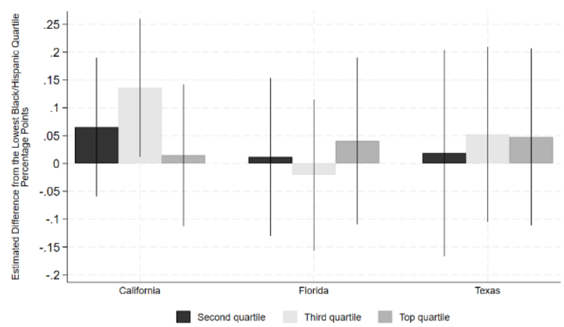


Algebra II

(E) Estimated difference from the lowest school poverty quartile



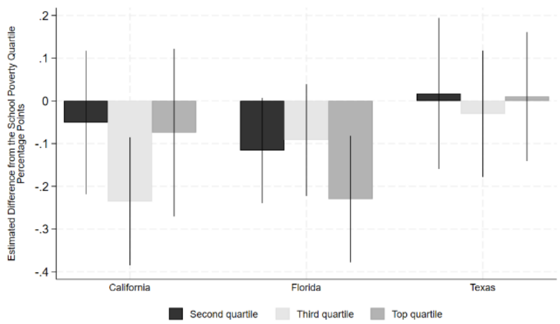
(F) Estimated difference from the bottom quartile in Black/Hispanic share



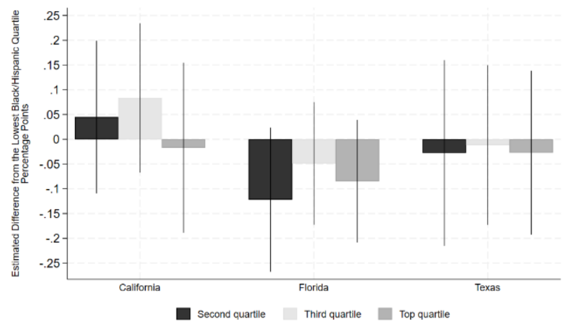
(Appendix Figure C4 continued)

Geometry

(G) Estimated difference from the lowest school poverty quartile



(H) Estimated difference from the bottom quartile in Black/Hispanic share

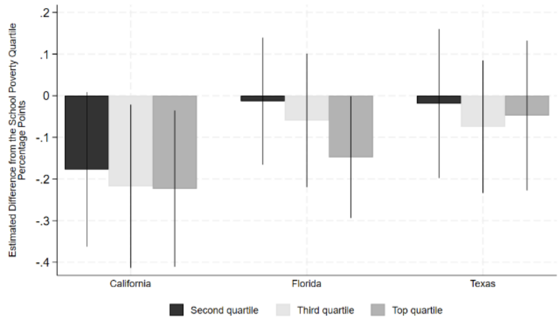


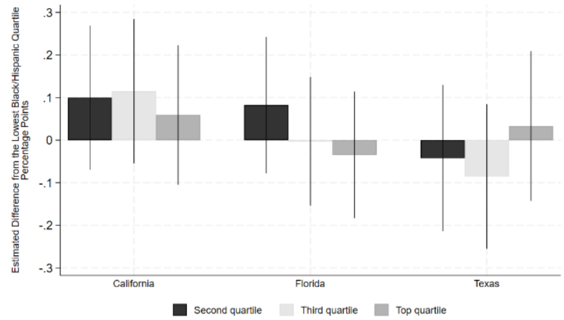
Notes: The outcomes of interest come from principal responses to the survey question: "This school year, which of the following mathematics and computer science courses are offered on site at your school for students in any grades 7 through 8? SELECT ALL THAT APPLY". We restrict the analysis to principals who indicated that their school served 8th or 9th grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles by state, using only survey-year fixed-effects as controls. The right panel repeats the same analysis using the share of Black and Hispanic students in the school. Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.

Appendix Figure C5. Math Courses Offered in Grades 9-12, by School Poverty and Racial/Ethnic Composition in Focus States

AP Calculus

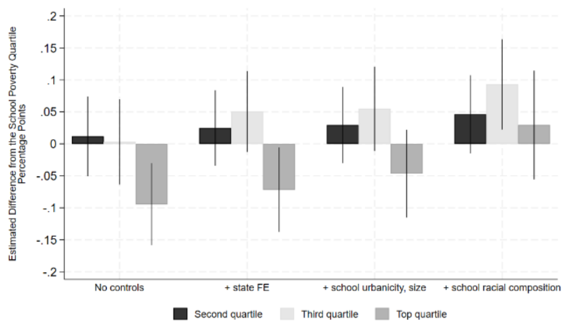
(A) Estimated difference from the lowest school poverty quartile	(B) Estimated difference from the bottom quartile in Black/Hispanic share

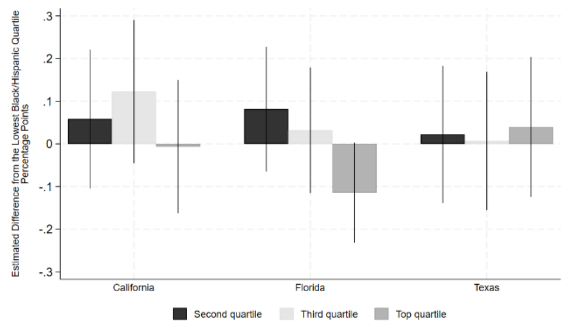




AP Statistics

(C) Estimated difference from the lowest school poverty quartile	(D) Estimated difference from the bottom quartile in Black/Hispanic share





Notes: The outcomes of interest come from principal responses to the survey question: "This school year, which of the following mathematics and computer science courses are offered on site at your school for students in grades 9 through 12? SELECT ALL THAT APPLY". We restrict the analysis to principals who indicated that their school served 8^{th} or 9^{th} grade. In the left panel, each bar represents the estimated differences between the principal responses in schools that fall into the lowest poverty quartile and the responses of principals in the second, third, and fourth quartiles by state, using only survey-year fixed-effects as controls. The right panel repeats the same analysis using the share of Black and Hispanic students in the school. Spikes present 95% confidence intervals calculated using standard errors that are clustered at the school level.